Parking Data Analysis

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It is hereby declared that

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2. The thesis does not include any already published or written by a third party content, unless it is properly cited in the references.
3. The thesis does not include any content that has already been approved or submitted for consideration for another degree or diploma at a university or other institution.
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Abstract

Car parking is a hassle for everyone in one word, but when it is in a country where population is an issue, parking problems can easily stress someone out. Car parking is a key contributor to traffic congestion and has been, and continues to be, a big concern as car sizes grow in the luxury category, limiting parking spots in metropolitan areas. The problem of a shortage of parking spaces is becoming more acute as the number of automobiles on the road grows rapidly across the world. Many countries' issues will increase without a planned and convenient withdrawal from the vehicle as the world's population continues to urbanize. Because it is impossible to handle the growing number of automobiles in a proper, comfortable manner with the present unmanaged car parks and transit amenities, an efficient and smart parking system is required. Here, An examination will be undertaken on a dataset of parking occurrences in this Learning Analytics Visualization project. This analysis will be able to answer some of the most crucial questions that may ease the parking problems. The use of parking spots will increase as a result of the implementation of this system.

Keywords: Parking; Parking Data Analysis; Machine Learning; Prediction; K-Nearest Neighbour; Decision Tree; Naive Bayes; Random Forest; Support Vector Machine; Bangladesh Parking; Parking location

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Chapter 1

Introduction

For many people, looking for parking spots in any business parking lot is a hassle. The high rate of new automobile registrations throughout the world exacerbates the situation. There are numerous contemporary parking spaces available, but many vehicles are unaware of the parking blocks or the parking system. Smart parking is a one-of-a-kind method for overcoming traffic congestion and saving gasoline. According to research, smart parking may save around 220,000 gallons of gasoline by 2030 and almost 300,000 gallons by 2050.[14] Individual parking system attempts have been locally effective but uncoordinated in the past several years, with businesses operating in their own area rather than leveraging generally applicable knowledge to extend their works within the city or internationally. The disconnect between existing parking programs and general transportation system design is a significant waste of space for cities to decrease transportation-related problems worldwide. This causes major noise pollution, and large areas of the city are filled with parked automobiles.[17] This analysis will be carried out in order to gain an insight into parking record trends. These revelations will answer the parking problem questions. Analyze the dataset's existing parking records related to critical questions (breakings, locations of parking spots, times of events). This marks the end of our project's data visualization. section. The latter point will be driven by the parking data we will have obtained using several machine learning algorithms that will be able to learn from historical data trends and forecast future data. outcomes. Data Modelling will be the name of this section of the project. The recommendations were based on the findings from both parts.

1.1 Research Objectives

This analysis will contain some of the most crucial questions about the parking systems. Then there will be issues and recommendations to match. Some examples include inquiries are:

1. Which parking locations are most used for parking?
2. When is the busy time for the parking locations?
3. Available Space in a certain time range for the parking locations?

The answers will include:

1. Recommend a free parking slot.
2. Recommend a parking location.
3. Show available space in a certain time range for a parking location.

These were the questions that steered our investigations in the right direction. To answer these To provide the following recommendations, we will look into past data trends as well as forecast future data trends.

1.2 Problem Statement

It is notable that, despite varying national settings, similar types of difficulty are noted by the writers, who have experience with parking specialists within ten Europe Union countries:

Parking Space Limitation

Automatic parking systems need to be used to determine a waypoint for a vehicle that is trying to park. The waypoint should not only determine the geometrics of the vehicle's movement, but it should also ensures safety. As a result, in order for the parking process to be safe and accurate, the corresponding constraints must be established and the appropriate parking path curve must be planned. This section examines the potential points of collision during the parking process.[3]

The high cost of construction or installation:

A good, functional parking management system comes at a considerable price. This is due to the system's numerous components. Some businesses may be unable to do so. Consider the possibilities. People don't have to stress about extra payments when they pay to have the system running all at once. You will be free of any penalties, costs, or cases for using traditional methods for next few months.

Maintenance

Although the system is automated, it is necessary to do regular maintenance visits. This is to make sure that the system is in perfect shape.

Disintegration

Problems of anysystem is unavoidable.That time, vehicles may lose the tracks of parking spots and slots.On the other hand, it could also cause cars to park in inappropriate sports. By stand agreements with the manufacturer will help because they will understand and solve the problem faster.. Delays may last a few minutes, depending on the severity of the problem.[12]

Functional problems

There aren't enough parking systems and enough demand for advanced parking systems to produce enough revenue to invest for development for parking zones in largely residential neighborhoods. Poor management, payment problems, a negative perception of collecting fees and fines, and problems of parking huge vehicles are all issues with the current parking regulations. Parking management operations need innovative solutions.[4]

Space issue

Major problem of parking issue is the space. Southern and eastern European towns with extremely high densities and, in certain situations, greater rates of automobile ownership than in northern and western Europe are severely affected by this issue. The aforementioned issues are common in cities and are equally important for local officials to address. Depending on the city, they may be more or less important.. The literature makes it abundantly evident that people's choice of mode of transportation can be significantly influenced by parking[3] . Parking management should start from the perspective of how it might assist goals like improving economic growth and decreasing congestion, for instance, which may be included in the mobility plan's objectives.[1]

Tendency to hide data

When we were collecting Data for our research most of them were unwilling to share their information about their data. Moreover, they skip and handful amount of entries to their notebook and keep those records in other some kind of small handbooks of their own and hide it in their pockets, those which didn't have any smart counter or system. then we noticed something interesting about the parking garages' activity and their reason not to share their data or even skipping some entries to keep that money to themselves as their side income for these reasons they don't want to share their data as they will get caught. not all of them have this intention but some of them do this. Most of them just say that they can not share data and say that it is classified. which made work data collection harder than it should be.

1.3 Motivation

We live in Dhaka city which is considered as one of the most busiest city in the world and it is densely populated. It is no stranger to eye in our country that people often park at the sideways of the road. One of the main causes of the deteriorating traffic situation in major city centers is illegal on-street parking. Vehicle owners are frequently forced to park illegally on the streets due to inadequate and badly maintained parking spaces. Such parking encroachments endanger the lives of pedestrians when they move onto walkways. Even the biggest roadways may become congested because of unlawful parking. Contrarily, some highways suffer more traffic than they can handle. Therefore, expanding the roads is only a short-term solution to the problem. There can be many reasons for that but we can confirm that most of the time it creates problem for the passing by vehicles. It is one of the reason why Dhaka has traffic jam issue. To our observation most of these cars are private cars, jeeps etc. So it came to our mind that why would they not park in the parking lots. That is how we found out the real problem of our research. Some parking places during rush hour is overly crowded with vehicles while some of the parking places are not having enough activities. Most of the people are not aware of those places and they are also not aware if their desired parking spot is crowded or not. So it motivated us to run test on the existing parking systems and activities to find our where people is often to go to and what are the places nearby that does not meet enough activity as it supposed to. By this way, we can narrow down the list and efficiently find suitable spots. We expect our system to minimize the number of problems related to parking also solving the sideways car parking issue. With that, we also expect it will solve one of the biggest problem of Dhaka city which is traffic jam.

Chapter 2

Detailed Literature Review

The optimal use of parking space and the abruptness with which vehicles are parked are significant variables in today's parking management system. The management of cars from the moment they enter the parking lot until they depart is automated and sophisticated with the use of technology-based parking management systems. In several cities around Bangladesh, optimizing automobile parking space remains a challenge for businesses, government offices, various public areas, and municipal authorities. According to studies, the average volume of traffic due to parking during peak hours might reach 30 –50 peasant of total traffic [22] .
Now the question arises what should be the steps required to solve these problems. The answer is simple; Smart parking technology has the ability to improve people's lives by addressing urban mobility concerns. The goal is to convert the parking system by addressing some of today's most pressing parking issues. We are ignoring the analog and focusing more on the digital parking system by empowering motorists to search, book, and navigate to appropriate parking spots with solutions for parking lot operators, commuters, local governments, and IoT users. It is critical to manage parking in order to create livable communities. Only by utilizing technological solutions can we plan, create, implement, and sustain genuinely smart cities.

2.1 Smart Parking System

As a result of digitalization, smart parking systems are starting to provide solutions for urban transportation. Smart Parking is a parking strategy that combines technology and human ingenuity to accomplish faster, easier, and denser parking of automobiles for the majority of the time they are idle [20]
. The essential ecological notion that we are all connected underpins Smart Parking and its sister technique, Intelligent Transportation. The movement of people and commodities requires both parking and transit. The vision and overlapping technologies of Smart Parking and Intelligent Transportation are progressively merging into one integrated stream.

2.2 Smart Parking System Architecture

A Smart Parking system must be able to estimate the number of open spots and the number of occupied spots in a parking lot, whether it is on the street (as in a city center) or inside a perimeter, i.e., bounded by an entrance and exit gate. The Internet of Things (IoT) makes it simple to install embedded sensors in urban areas for environmental monitoring and security. These sensors allow for highly accurate measurement of temperature, humidity, radiation, electromagnetic, noise, chemicals, air quality, and other environmental states and events. They can measure the movement of pedestrians and other urban infrastructure elements like traffic. These gadgets may be able to provide information on the neighborhood environment that is pertinent to the area being investigated when employed in urban settings. IoT also comprises regional and global infrastructures that link physical objects to enable better services based on established and developing interoperable ICTs, such as cloud computing, cloud storage, and other current Internet technologies. Through the internet protocol, things can communicate thanks to IoT.[15]

2.3 Access Management Using Geographic Information Systems and Traffic Management Tools in Pennsylvania

A novel approach to access management based on traffic impact tools is provided. The approach is intended to measure the impact of projects paired with significant activity centers. Because of the size of the influence of important developments, it is necessary to examine their regional and local implications on transportation networks. The presented technique combines regional and local traffic models and employs geographic information systems (GISs) as auxiliary aids. It was developed as an access control method for computerized models, and it addresses supply-side transportation improvements (e.g., number of lanes, signalization, and parking controls) and their affect on pedestrian traffic in an attempt to develop better numerical methods for traffic identity and access management by taking local and metropolitan traffic impacts into account. Users can utilize GIS technology to design comprehensive roadway networks for use in regional planning. Users can design comprehensive highway networks using GIS technology for use in regional forecasting models and smaller traffic simulation models. The data, models, and software utilized are described, and an application example is supplied. The preliminary findings demonstrate the concept's and models' effectiveness. The major innovation creates not only increased traffic volume on the network, but also route-choice modifications impacted by the degree of service on the various pathways in the study area, according to the regional model. A local model coupled to a regional model via interface software is another component of the new model. Two scenarios were simulated using Traf-NETSIM to assess the effectiveness of this theoretical model. The access control scenario was shown to be effective in twenty-four different simulation trials.[5]

2.4 Internet of things (IoT) based traffic management routing solution for parking space

The concept of an Internet of Things (IoT)-based traffic management and routing solution for parking spaces arose as a result of automobile parking being a critical challenge in metropolitan areas. The increasing number of automobiles has exacerbated today's congestion and parking problems. The primary goal of this project is to aid the user in locating an available parking place, hence saving time and fuel usage when looking for a parking space. This suggested approach was utilized digitally via a web application to help individuals discover available parking spaces. In reality, the system calculated the available parking spot occupancy and alerted the client via the application process. To be honest, the machine was outfitted with an ultrasonic sensor, which served as the analyzer, sending information to the microcontroller for updating into the UBIDOTS remote server for data acquisition purposes. This solution might reduce or eliminate the time control issue at the parking garage, allowing users to save time by checking the available parking areas in advance via the online application.[2]

2.5 Smart Vehicle Parking Monitoring System using RFID

RFID is the most basic technology for wireless transmission of information over systems. Despite this,Although technology has been accessible for some time, new standardizations and affordability have substantially increased its value. This technique communicates and gathers information from things that have RFID tags attached to them via magnetic waves. Any industry that uses RFID tags has seen a significant gain in efficiency and production. RFID is frequently used in tracking systems, monitoring systems, and parking systems. It is also commonly utilized in automation, which is developed utilizing technologies such as RFID readers, RFID sensors, RFID controllers, RFID writers, and many more. With the mass influx of population in industrialized, industrially and technologically sound urban areas, there is an urgent need to make the cities smart. Data exchange, artificial intelligence, machine learning, analytics, and hundreds of Radio frequency and sensors are used to make cities smart. One of the major problems of today's smart cities is the rising requirement to control automobiles on the carriageway as well as to build sufficient and well-managed parking spaces to decrease traffic congestion in metropolitan areas. This necessitates the development of a highly automated parking management system capable of directing the motorist to an open parking place in the surrounding region. A true example of a smart parking system (S.P system) based on the Internet of Things is presented in this study (IoT). The suggested intelligent parking system is based on a digital system that gathers parking room availability and aids vehicles in discovering and selecting the needed parking spot among the available parking spaces, therefore significantly reducing traffic issues and inefficiencies throughout towns. With the use of Radio Frequency Identification (RFID) technology in automation, transaction costs and stock shortages have been significantly reduced. The majority of RFID networks provide a variety of automation. RFID readers, RFID writers, RFID barcode scanners, RFID smart sensors, and RFID controllers are examples of these innovations. In this study, RFID technology was used to provide a solution to issues experienced in parking-lot systems. RFID readers, RFID labels, electronics, barriers, and software are the primary RFID technology elements. The technology has been employed for the management, control, contract reporting, and function of parking lots located throughout the city. RFID readers, tags, and obstacles will be used to control parking-lot check-ins and verify.This new tech will significantly reduce personnel costs. In the future, unmanned, secure, and automated parking lots using RFID technology will be feasible. Verification and check-outs will be dealt with quickly without requiring cars to stop, avoiding traffic congestion during these processes. Operators will not be required to stop at circulation pts, and parking tickets will be invalid during verification and check-outs. Boarding pass noise issues for ticket production machinery will also be prevented.Vehicle owners will not be required to pay anything at every verification, allowing for faster traffic flow. Because there will be no waiting during check-ins and check-outs, combustion gas creation as a result of such waiting will be avoided. An automated revenue tracking system, a charging car tracking system, and a central parking-car tracking system have all been created and implemented. Instead of parking cars on the streets, a more modern and efficient parking-lot system has been created.[21]

2.6 Smart parking management system with dynamic pricing

Smart parking is becoming an increasingly important component of smart city plans. Accessing and maintaining parking spots is a difficult undertaking since space is normally restricted, locating unoccupied spots is difficult, and individuals want to park their automobiles near their favorite locations. During rush hour, this is exacerbated in important/posh neighborhoods of big metropolitan centers. People must travel about a lot to find a suitable parking place due to the lack of a robust system for managing parking. This wastes vital time, consumes unneeded fuel, and causes environmental damage. This study offers a smart parking management system (SPMS) based on a various objectives based parking space reservation algorithm (MCPR) that enables vehicle drivers/owners to discover and book the best suitable parking spot from anywhere at any time. The system also covers the notion of variable pricing strategy for determining parking fee in order for government agencies and private investors to get more money. For improved parking control and planning, the system uses sensors to compute the density index and average inter-arrival time of cars in a parking space. The model findings demonstrate that the suggested method minimizes the average extra driving required by customers to locate a parking place, hence reducing traffic jams and, as a result, air pollution. In recent years, the quickly increasing number of cars has caused long heavy traffic and difficulties in traffic management in cities. One of the biggest substantial factors contributing to increased traffic congestion just on highway is unapproved and unpermitted parking. Furthermore, due to poor management, a shortage of real-time parking guidelines for operators, and complete ignorance, trying to manage available parking spaces cannot achieve the desired reduction in traffic queue problems. Because the amount of roads, major roads, and associated tools has not grown exponentially, there is a growing demand for a smart, dynamic, and useful vehicle remedy. As a result, a parking guidance system can assist handle parking successfully and make it simpler for automobiles by using several detectors, an appropriate communication network, and advanced computational resources of edge and distributed technologies. In this article, we propose a multiple-layer structure for a smart parking system, which includes inter parking slot sensor network, the most recent long-range minimal wireless communications systems, and Edge-Cloud data processing. The suggested solution permits dynamic parking management for massive swaths while providing valuable information to drivers about availability of parking locations and services related via near real-time vehicle monitoring. Moreover, we suggest a dynamic valuation method to maximise profit for the transit authority whereas maintaining adequate status of the parking availability for drivers. [23]

2.7 A Hybrid Technique for Smart Parking Management System in a Smart City

In light of the urban context, we presented a new "Parking Management System" paradigm. The comprehensive model includes the fundamental aspects of the smart parking. The method allocates the driver a specific parking space. It comprises the closeness to the location and the cost of parking based on user requirements. The total parking capacity is effectively used. The system method resolves the issue in a time-driven succession of discrete decisions. This represents the most advantageous approach based on the current state of affairs and subject to random happenings including the request of a new user and the availability of a parking place. The assignment is modified at the next judgment point to ensure that there are no conflicts in the resource reserve and that the assignment of resource has a greater cost than the current cost of function value. The suggested system allows users to locate free parking spaces based on new performance measures that assess the cost of user parking by distance and total number of available spaces. The system demonstrates that the approach enhances the chance of successful parking while minimizing user waiting time. We effectively applied the recommended system in the actual world. In past few decades, numerous built-up societies and urban areas have formed Parking Instruction and Information (PGI) frameworks for efficient parking management systems. PGI methodologies provide appropriate information on parking within monitored areas of the system and direct drivers to useable parking spaces. The traffic management system handles the cost of hiring people as well as the best use of resources for car parking. Nevertheless, it is common for an operator to be punished severely for a colored parking space in the major road due to luck and incident. This process is lengthy and may result with the worst-case scenario of not discovering any parking spot.The intelligent parking system was designed to decrease the cost of hiring workers and to provide owners with the best location for car parking. The option to provide a large parking space in a realistic situation to avoid parking problems. When contrasted with the previous system used by the city, this is by far the most efficient. In any particular instance, this is not the best approach for the parking system.In published findings, the researchers utilized a wireless sensor network to depict latest tech in vehicles and infrastructure. To use this framework, the operator can learn about available free slots in the area. The driver in this system makes use of phones and table PCs.Using real-time data manipulation, this comparing the predicted to do is provide information about the best nearby parking spots. If the owner wishes to purchase a parking space with time slots, they can do so via smart phone or web site.Evey car contains an RF ID that can be utilized to authenticate the machine. However, the existing system is inefficient in terms of finding available parking spaces. The structure does not solve the load systemic issue and does not generate net income. [13]

2.8 Related Works

This part aims to critically review previous relevant work in the field of Smart parking technology and analyzing parking data. Currently a lot of organizations have implemented many ways of analyzing parking information from datasets and giving results on the best result. According to the research and services that are available, it uses a technology called SmartCloud which uses wide range system with real time interacting intelligent Iot service system using open web interfaces that can enable knowledgeable and pliable services[6] SmartCloud is a cutting-edge,

all-encompassing service platform that collects data from thousands of deployed sensors and devices and transforms it into useful, real-time investigation. It's set up to handle millions of interactions with enormous networks of sensors and information technology, as well as interface with other systems, delivering real-world answers to millions of people around the world. SmartCloud allows the users for structural deployment of upgrades to their whole network of devices while also offering secure control devices and managing firmware. This technology is built with cutting-edge web technologies, allowing for secure universal access using conventional web browsers. According to, they found a solution by installing a smart parking solution with dual-sensor technology in private buildings to assist facility and security managers with real-time parking spot management. The battery-powered SIGFOX sensor is rated IP68 for dust and water resistance, and can survive extreme temperatures and large trucks (up to 15 tonnes) for up to 9 years. To inform building management of parking availability, occupancy data is wirelessly relayed to the cloud. Its one-of-a-kind vehicle recognition functionality can even help with billing and location. The data is subsequently compiled in the APP and made available to all drivers. It lowers traffic congestion and the time drivers spend looking for a parking spot. Currently, the solution is in use in Taipei (1000 sensors), Tainan (2000 sensors), and Pingtung (1600 sensors)[16]

D. J. Bonde, "Automated automobile parking system directed by android application," Proc. IEEE Conf.,03-05, January 2012 The project's goal is to automate both automobile parking and car operation. A scaled-down version of an automated parking system that can control and manage the number of vehicles that may be parked in a specific location at any given moment based on the availability of parking spaces. Parking existing vehicles using a sensing device is known as automated parking. An android application is used to control who enters and leaves the parking lot. [11]

"Intelligent Parking Space Detection System Based on Image Processing," The purpose of this work is to offer an intelligent parking space authentication protocol based on image processing that can capture, process, and produce information about vacant automobile parking spots from a brown circular artwork created in a parking lot. It will be shown in real time at the display unit that has seven parts. The amount of parking spaces currently available in the parking area is displayed on the 7 section display. This solution proposal has been created on a hardware and software platform.[9]

International Journal of Machine Learning and Computing. The automatic parking system and electronic parking charge gathering based on license plate recognition were explored in this study. The goal of this project is to create and deploy an autonomous parking system that will improve the public parking lot's convenience and security while also collecting parking fees without the inconveniences associated with utilizing magnetic cards. The automated parking system won't require magnetic cards or their associated equipment, reducing the amount of human involvement. Furthermore, it contains a parking assistance system that may direct users to a parking place. The system recognized numbers via signal processing. The parking and charging system operated using image processing to identify license plates. In general, the systems operate with a pre-programmed controller to provide access control in limited areas while requiring the least amount of human participation in the parking system.[7]

"Smart parking system with image processing capacity." Smart Parking Systems gather data about vacant parking spots, analyse it, and then position the automobile there. Based on the suggested architecture, a parking assistance system prototype was created. The efficient spherical design is provided with a novel rack-pinion system utilized to raise and position the automobile in a certain location. [8]
Actually, there had already been a significant amount of work on the smart parking. The summary and disadvantages of them are discussed below.The authors of this paper Femilda Josephin J S.et.al made a"Parking made much easier an embedded design." They introduced a particular design of a real time intelligent parking system that used PIC 16F877A embedded systems for wireless communication to enable the consumer with remote accessing control of elements such as lights, detectors, and gadgets that are displayed inside of their operating range of the surroundings in this layout. This type of technology is intended to assist users by assisting them in parking their vehicles in the parking lot. On the basis of handling all sensor data, the system automatically provides all details in the parking areas. Despite research, this scheme could not lead to a better position in the parking system because it used low-end devices. Pampa Sadhukhan created "An IoT-based E-Parking System for Smart Cities" in [2]. As a consequence of the increasing number of vehicles on the road and the lack of available parking space, transportation issues arise, as does increased traffic congestion in congested cities. Pampa Sadhukhan created a prototype of an internet-of-things-based E-parking system. This E-parking system made use of an essential part known as a sufficient period to address the aforementioned issues while also providing smart parking management in congested areas.As a result, it is necessary to develop an automatic smart parking management system that will assist the operator in rapidly locating an appropriate parking space for his/her vehicle. Despite the fact that there are numerous research efforts on the development of smart parking systems in the publications, the majority of them have not addressed the problem of real-time identification of appropriate parking and automatic collection of parking fees. The main disadvantage of this system is the lack of progress reservation or position discovering.[19]
In latest days, a smart parking system has been developed to alleviate vehicle park-

ing problems in urban areas. A few elements and endpoints are used in the design of this system, such as the low efficiency of the iot device and the elevated implementation costs of the cellular network. The information from the member nodes is transferred by a Wideband Internet of Things (NB-IoT) module in this type of system, which is a new cellular technology introduced for Low-Power Wide-Area (LPWA) applications. The server houses components for basic information management, charge management, sensor node surveillance, multitasking, and data analytics. The mobile application is designed for drivers to be simple and easy to use, with added third-party payment policy and parking advice service. Despite having more functionalities than previous existing technologies, a few characteristics and sophistication remain in this structure. [18]

Chapter 3

Description of the model

In this research we took data from different parking places of Dhaka city with different time frame. we will get a detail idea of the parking situation of Dhaka city.

Libraries Used for handling Data

1. Wrangling: For data wrangling and cleaning, we utilized pandas and NumPy.
2. Visualisation: Seaborn was used for our visualizations. The matplotlib visualisations also featured seaborn style.
3. Modelling: The Python sklearn library was used for data modeling.
4. Cotroling version: GitHub was used
5. Demo Showcase: Gradio was used

3.1 For Location and Time

Cleaning of Data

a description of the steps taken to prepare the data for analysis

Obtaining data

We utilized the function to make sure the data was loaded properly. First, we made sure that all the columns loaded in by using the data.head function. Then, to ensure that all of the rows had loaded, we utilized the data.tail function.

Types of Data

We used the data.dtypes method to verify that all the data types were accurate. Each column's data types are displayed.

Type, Upper or Lower Case

On each column with categorical values, we utilized the value counts() function to check for errors such as typos and cases. It is simple to spot typos or other case-related difficulties thanks to the function that combines together, counts, and shows all identical responses.

Whitespaces

For each column, we used the str.strip function to get rid of any excess spaces in the data.

Upper or Lower case

After identifying the values with a case problem, we used the str.upper method to change all of the values to uppercase.

Outliners Checks

We created a box plot to check for outliers, which made it very simple to identify the outliers.

Missing Data

The "isnull" method was used to discover missing values. It demonstrated that there were no values that were missing. **Data Wrangling:**
A breakdown of the significant executive choices made in relation to data preparation.

Changing time to date/time data type

Regarding the datatypes of the fields, only one choice was taken. We had to convert these attributes into date/time objects for several reasons. This is so that we can utilize time-based functions to explore the data in these areas. This category includes any descriptive or prescriptive analytics that take into account the timing of each parking record.

Putting all to uppercase

Except for a few, the most of the string data items were already capitalized. Instead of going through the tedious process of capitalizing the strings correctly, we believed it would be more appropriate to alter those strings into all capital latters for matching the rest of the data. For the sake of balancing string consistency.

Deduction to check there are no typos

It was important to examine the various inputs into each field during the data cleaning process; We may indirectly check for typos in the entries by doing so for the string fields. The additional data cleaning procedures were used to actively verify any string fields that had not yet been verified by those methods. After performing all of this and reviewing all of the inputs for all of the string fields, we found that none of them contained any spelling or other typographical errors.

Steps that were followed

1. Step one Choosing the target To predict an outcome, each classification model will need a set of fields as training data. The value of the target field, a different

field in the dataset, will be that result. It is necessary to isolate the field into a separate variable.

2. Step two Finding the characteristics Based on the models' training utilizing data from other fields as training examples, the value of the target field is predicted. At this stage, the model can be trained using any additional field in the dataset that is not a unique identifier.

3. Step one and two conbined creating forms with feature fields that are acceptable A classification model can only function with numerical values for the target and feature fields. In light of this, any field containing non-numeric data must be modified. To accomplish this for all string fields, use the valuecounts() function to replace each unique value in the field with a different number by iterating over all of the values. This enables the machine learning program to use the data while maintaining the data's integrity. The only other sort of data included in our study was date-and-time, which can be converted into numerical data by decomposing it into its component parts and assigning each one its own element.

4. Step Three Parameter Modification (first time) There are a number of parameters in each model, and each one has a conceivable range of values. The model must be modified for the given dataset in order to use the best possible set of parameter values that produces the highest level of classification accuracy. Using the Grid Search function of the Scikit-Learn Python library, we looped over all potential combinations to find the best effective parameter value combination for the dataset.

5. Step four Climbing a Hill Although not all of those feature fields will have a direct impact on the targeted data, the models have been run on all currently viable feature fields from the dataset. The Hill Climbing approach is used to assess the model's accuracy using different feature field combinations and densities. By eliminating any redundant features, this approach will only generate the feature fields that have an impact on the target field.

6. Step five second parameter tuning The parameters of the model can be fine-tuned once again for increased accuracy using the collection of crucial feature fields. This is so that we can now fine-tune the model using only the crucial features rather than every feature that is available.

7. Step six The model is tested and trained We can now start using the classification model now that we have a focused set of features and a hyper tuned model. Since there is a limited quantity of data available, a subset of the records is used to train the model by teaching it which traits or values in a record lead to the target categories or class.

8. Step seven output outcomes Different conclusions might be drawn from the model's performance depending on the type of class and other elements related to the business question.

3.2 For Available Space

Crating time Ranges: As we have 2 weeks of data, we categorized the intime and out time of data to time ranges of an hour and how many vehicles are in that one time range.

1. Step one After reading the csv file we preprocessed the data like above and split the data
2. Step two we checked the unique parameters (Unique()) function and encoded them and mapped the parameters using the (map) function
3. Step three We extracted the categorical and numerical column names and Scaled them using standard scaler.
4. Step four we tain tested our data for fitting into the models.
5. Step five we have tuned the models and then used them and printed scores, confusion matrix, and classification reports
6. Step six We used Gradio to create a demo for our machine learning model

Flow chart of the Workflow

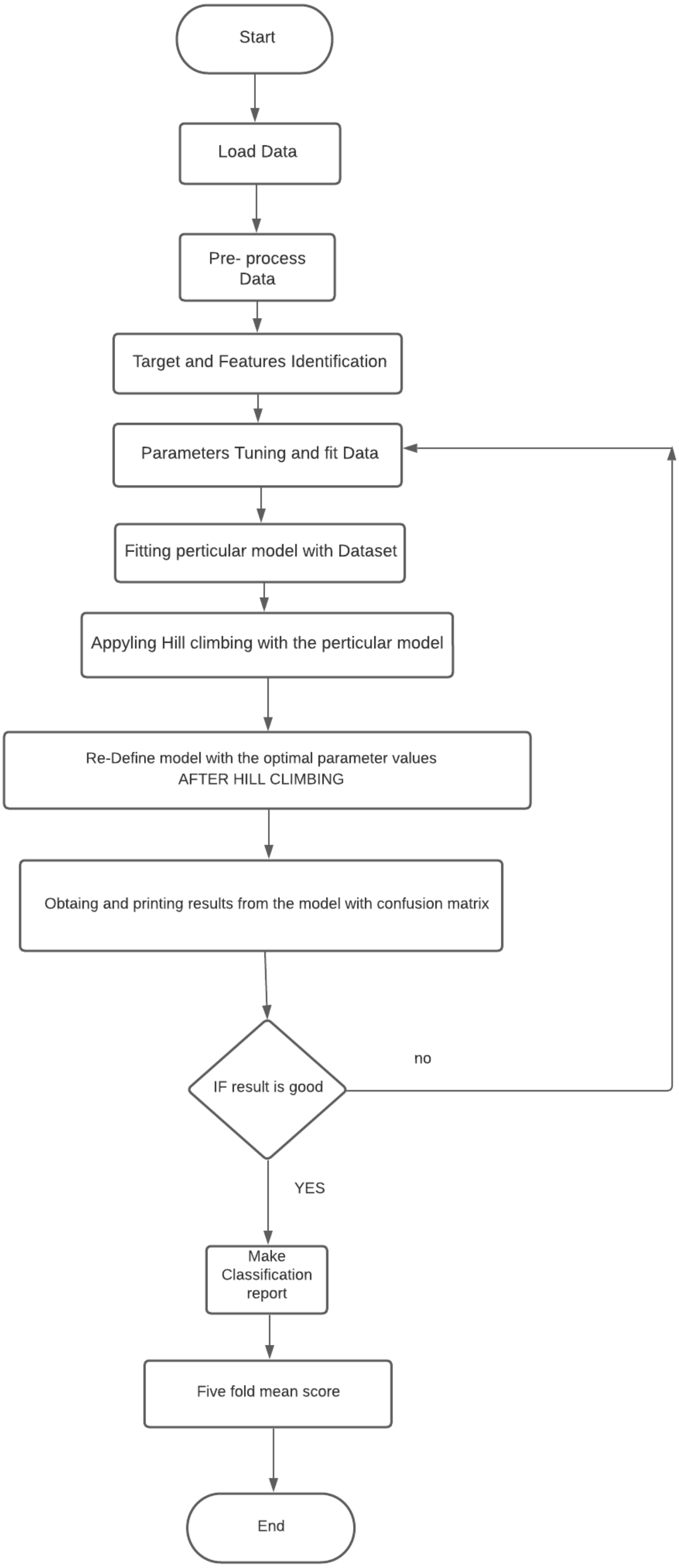


Figure 3.1: Flow chart of the Workflow

Chapter 4

Description of the dataset

In a country like Bangladesh where it is overly populated in a small place, people struggle with traffic jam a lot. There is always an issue of lack of parking space in a certain area. It is pretty tough to find data regarding parking in Bangladesh as everything is kept by the certain parking lot security or the owner as only hand-written on their diary. So we collected information from the parking managers. We have collected out Data transferred into excel sheet and stored in a CSV file. We have managed to gather information from 100 different parking systems throughout Dhaka city. It shows us the information about every car that is entering and departing time in a particular parking place. In the dataset we crafted, we added the information of the parking place name with the area and the street name so that we can locate it easily. We marked every car with the token number that the driver took during entering parking lot. From the diary, we gave entry in our spreadsheet about the time when a certain vehicle is arriving as well as leaving. Then we calculated the total time the vehicle was parked there. It gives us the idea on in which area of time there is more entry or you can say rush hour and which indicates more of a leisure hour. As Dhaka the capital of Bangladesh is heavily populated with people which results in mass amount of traffic which always comes with it's own problems. So we think this particular dataset will help us visualize the traffic information with the parking solutions. Rather than parking vehicle in the open space, it will benefit people with finding suitable place to park as well as solving the random violations of traffic.

Chapter 5

Results of analysis

Based on our dataset For our preliminary analysis we Pre-processed our data and used different types of machine learning algorithms to measure the accuracy rate of the data set and visualize the Data for getting the wanted reserch question answers.

5.1 Data visualization Popular Parking Area

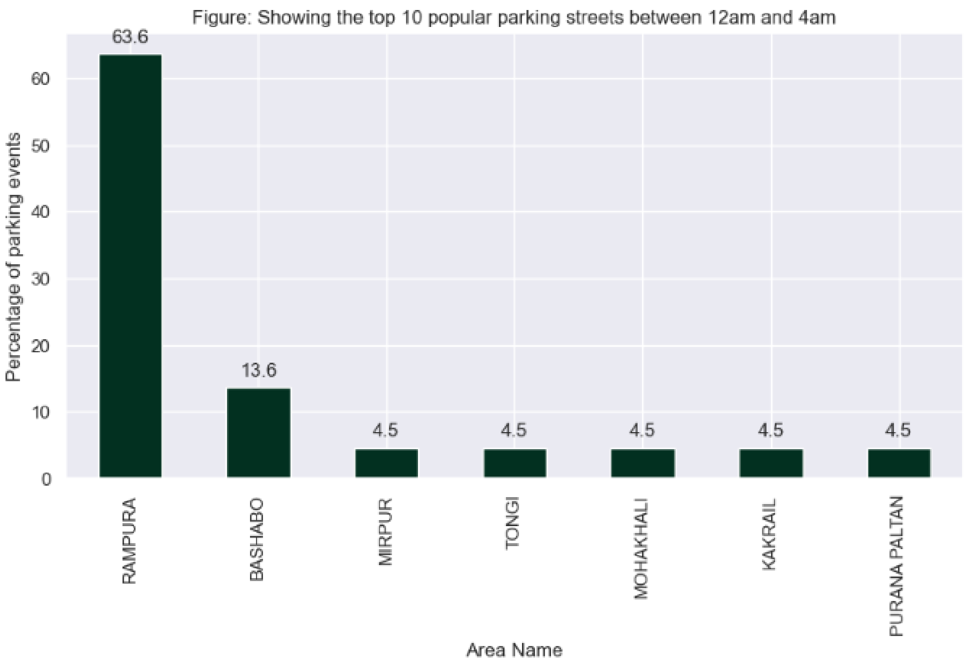


Figure 5.1: Data visualization Most Popular Parking Area 12am and 4am

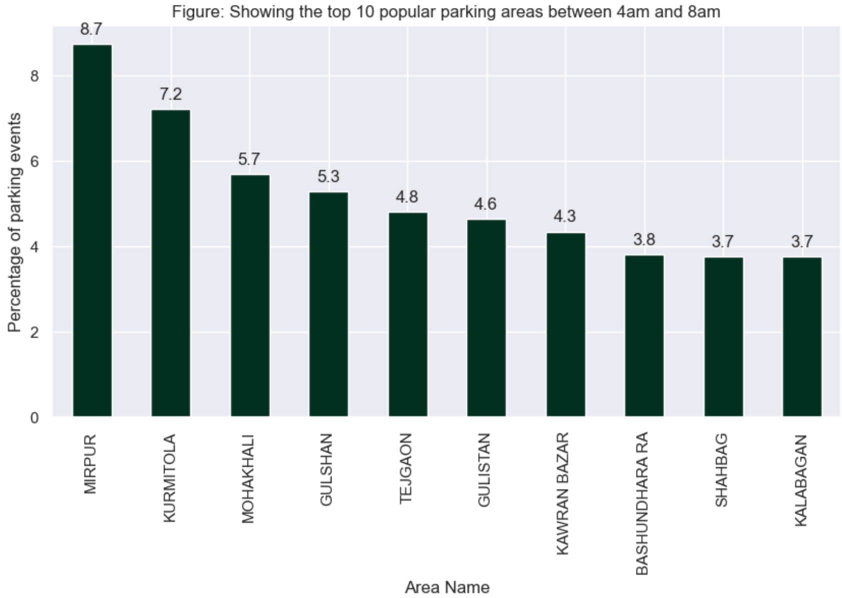


Figure 5.2: Data visualization Most Popular Parking Area 4am and 8am

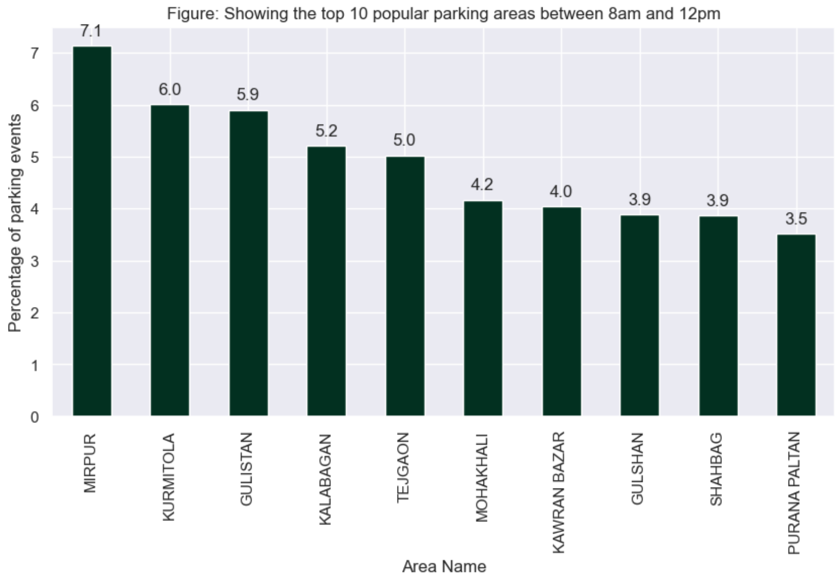
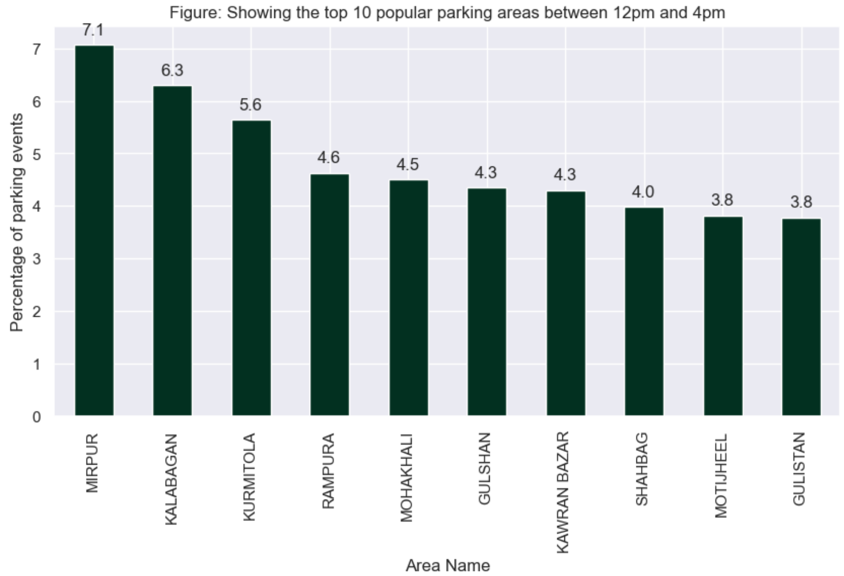


Figure 5.3: Data visualization Most Popular Parking Area 8am and 12pm



the

Figure 5.4: Data visualization Most Popular Parking Area 12pm and 4pm

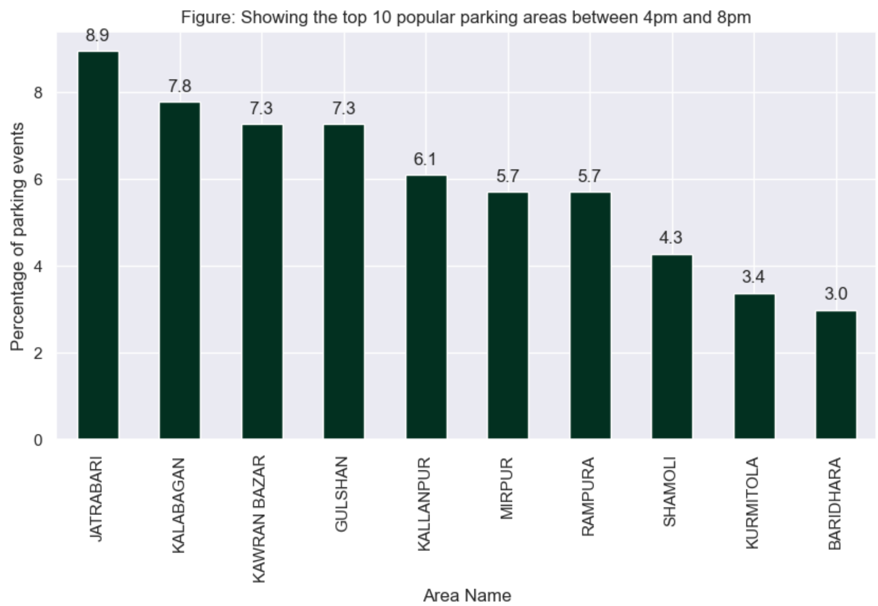


Figure 5.5: Data visualization Most Popular Parking Area 4pm and 8pm

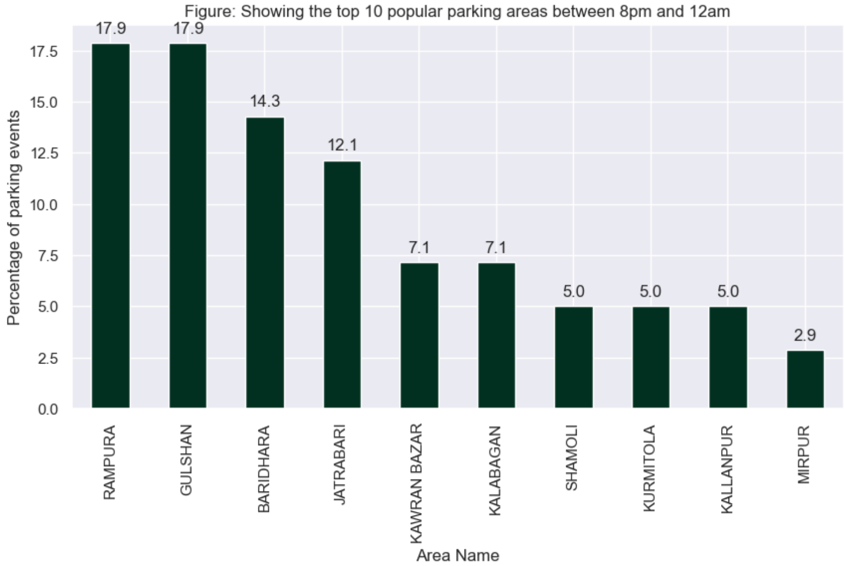


Figure 5.6: Data visualization Most Popular Parking Area 8pm and 12am

5.2 Data visualization Most Popular Parking Street

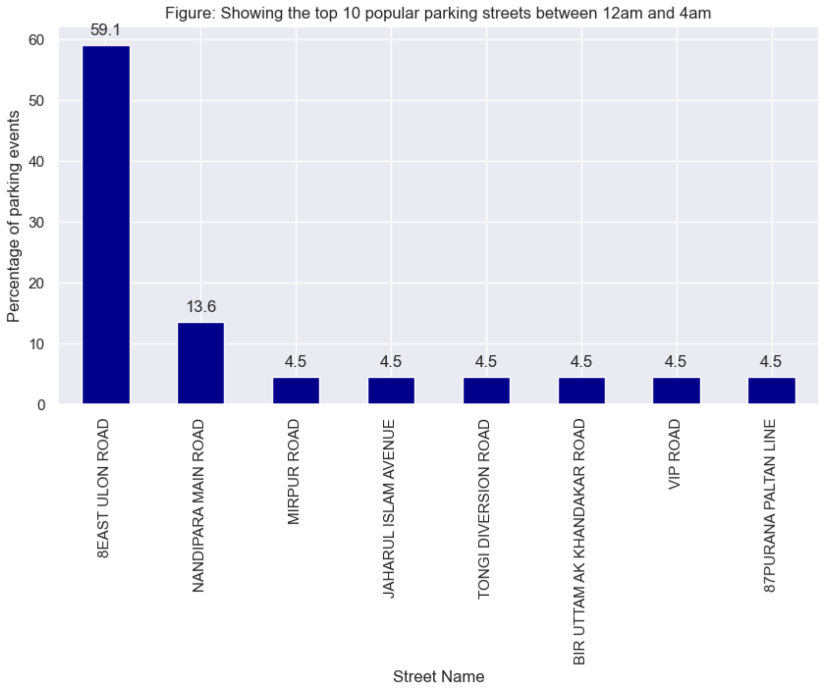


Figure 5.7: Popular Parking Street 12am and 4am

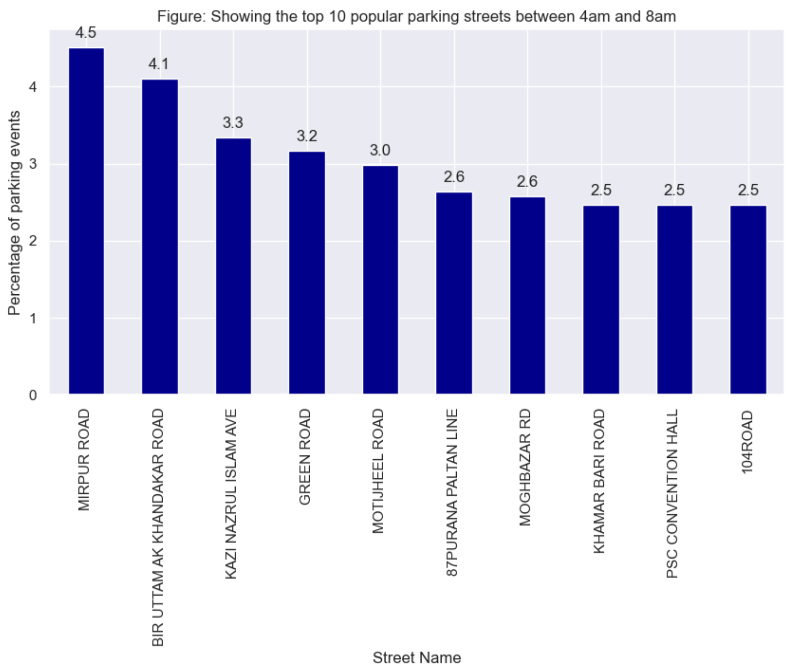


Figure 5.8: Popular Parking Street 4am and 8am

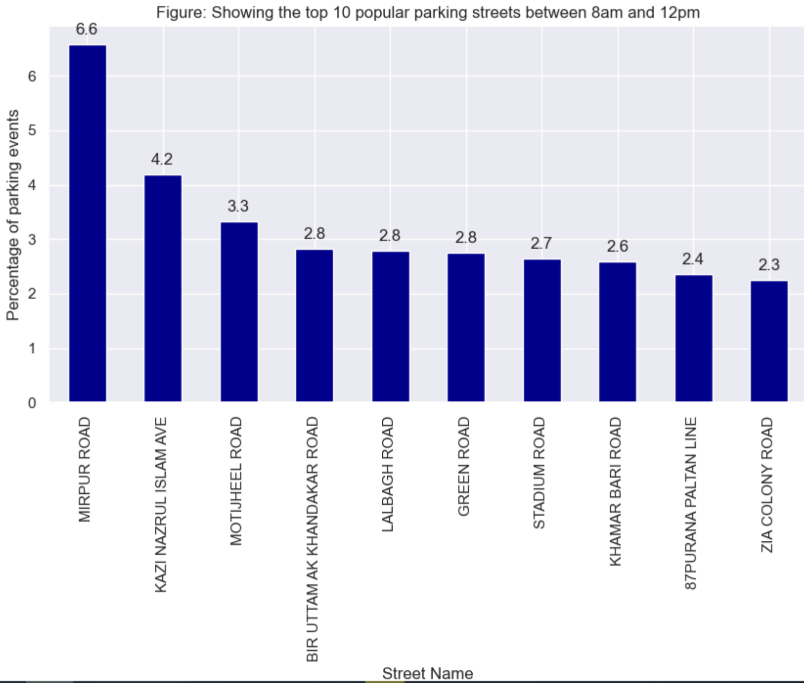


Figure 5.9: Popular Parking Area 8am and 12pm

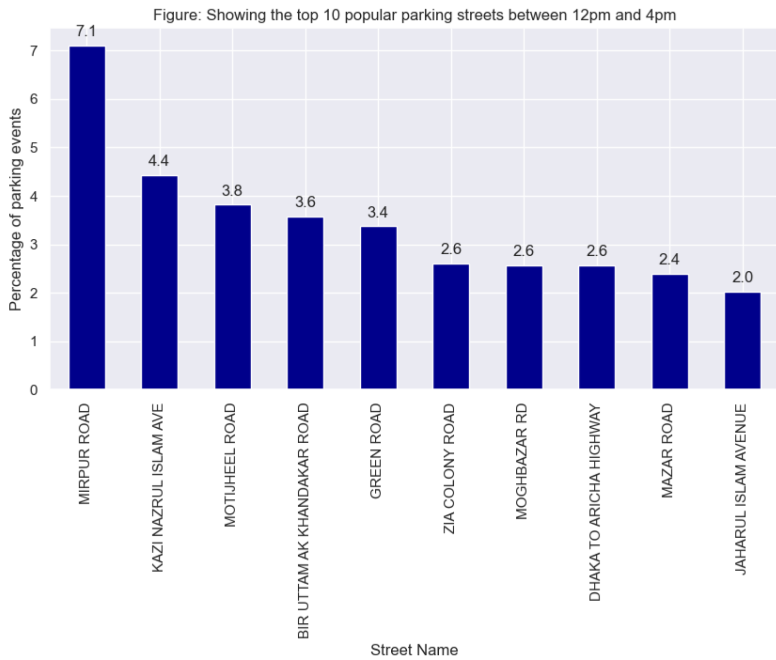


Figure 5.10: Popular Parking Street 12pm and 4pm

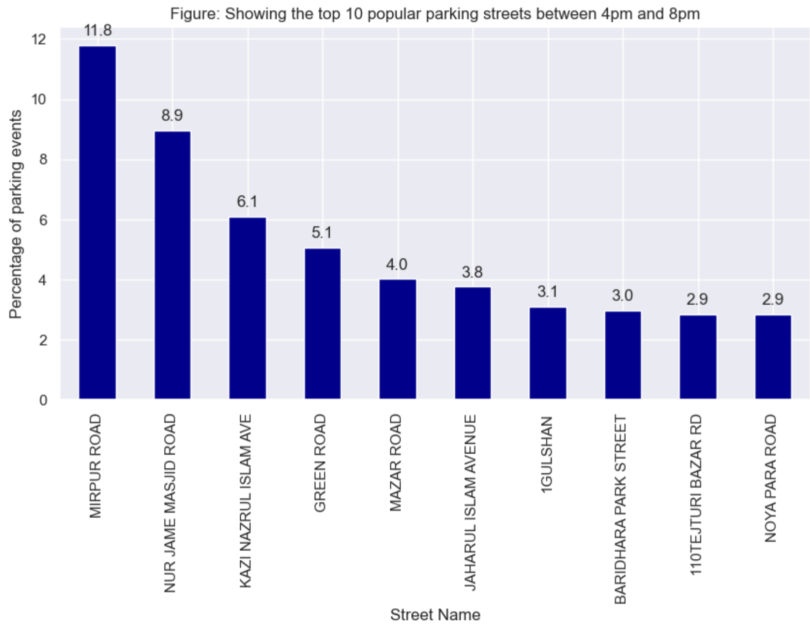


Figure 5.11: Popular Parking Street 4pm and 8pm

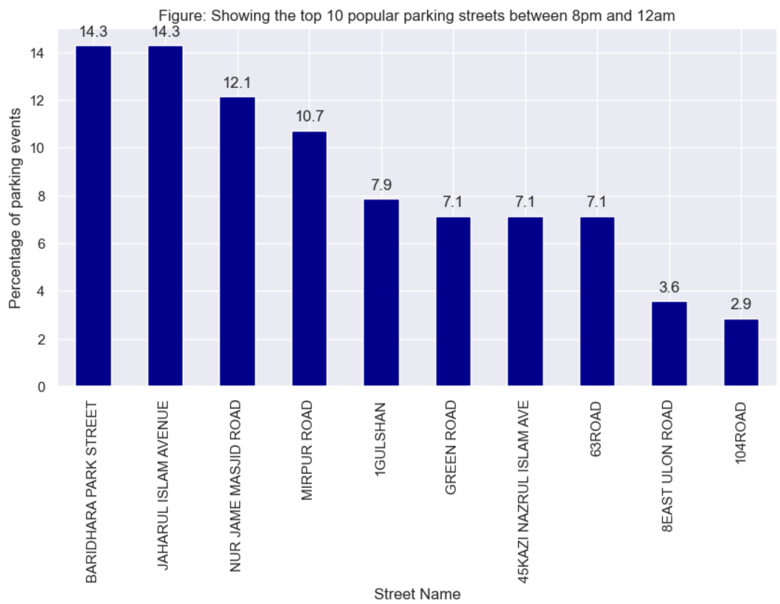


Figure 5.12: Popular Parking Street 8pm and 12am

5.3 Data Visualisation – Which is the busiest hour for each area

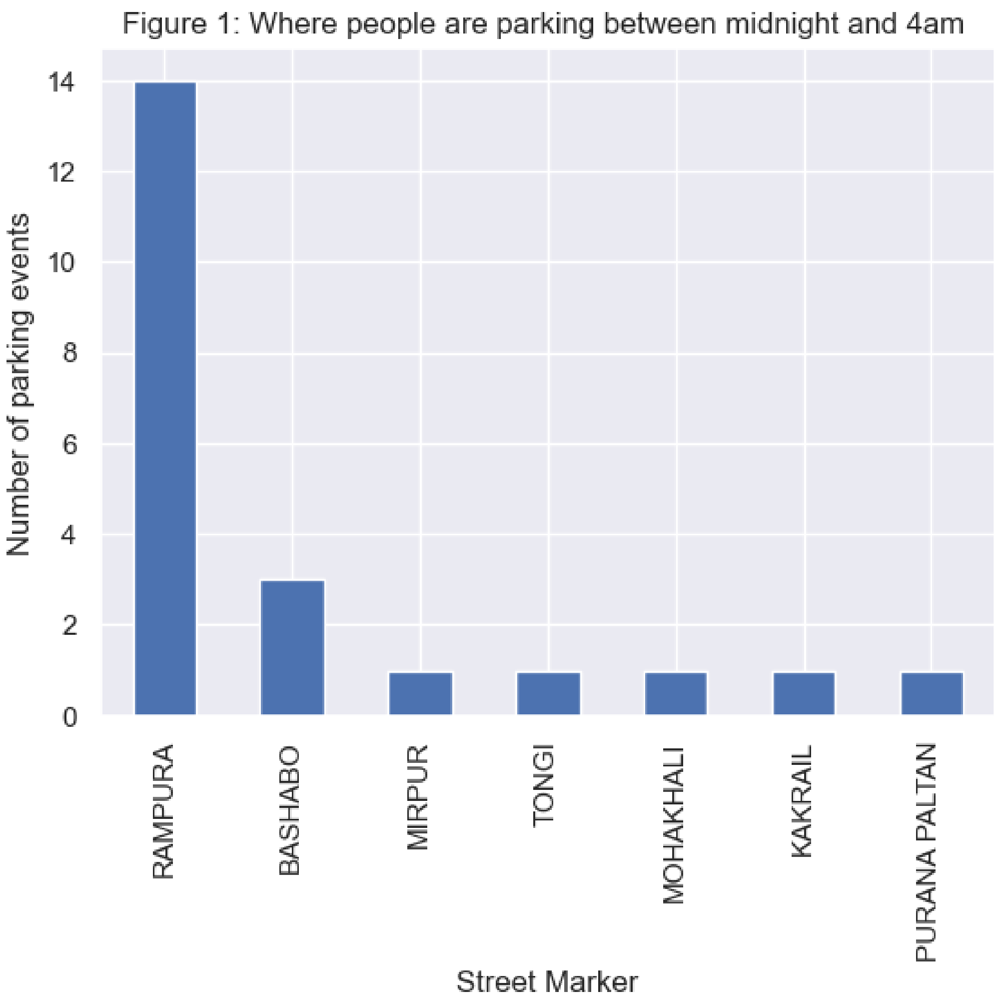


Figure 5.13: busiest hour for each area between 12am and 4am

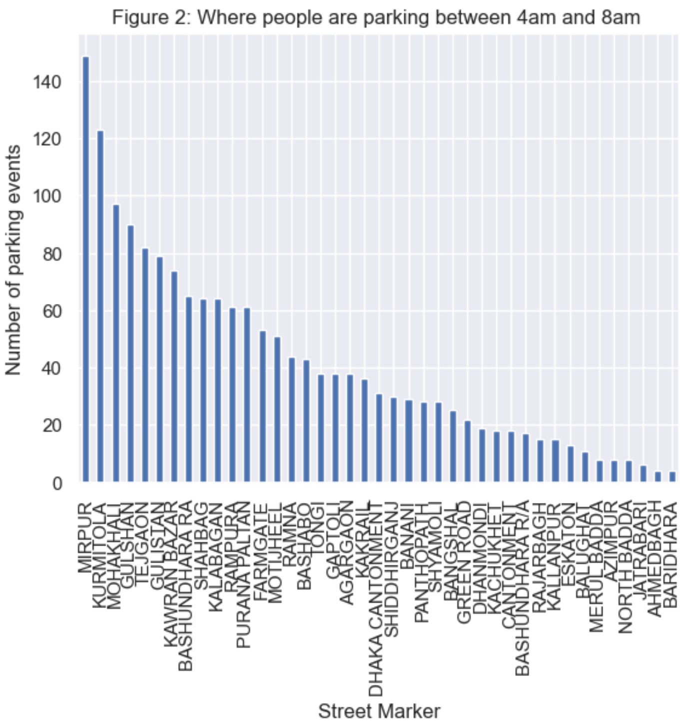


Figure 5.14: busiest hour for each area between 4am and 8am

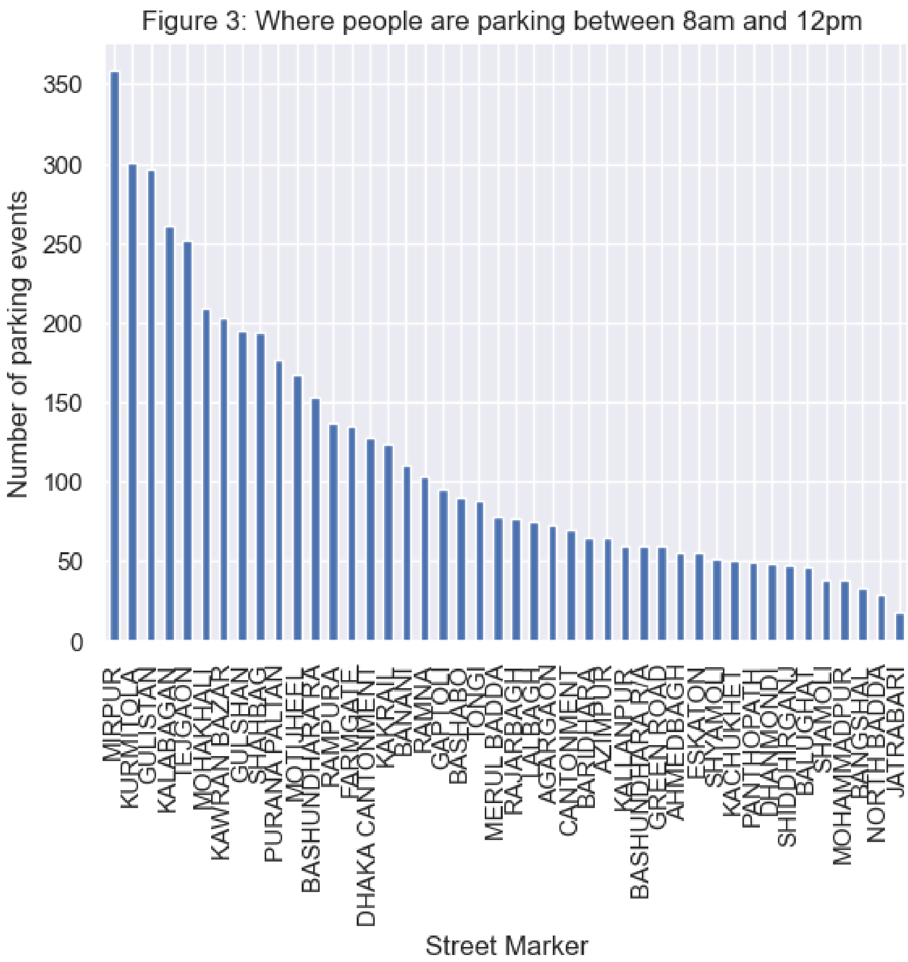


Figure 5.15: busiest hour for each area between 8am and 12pm

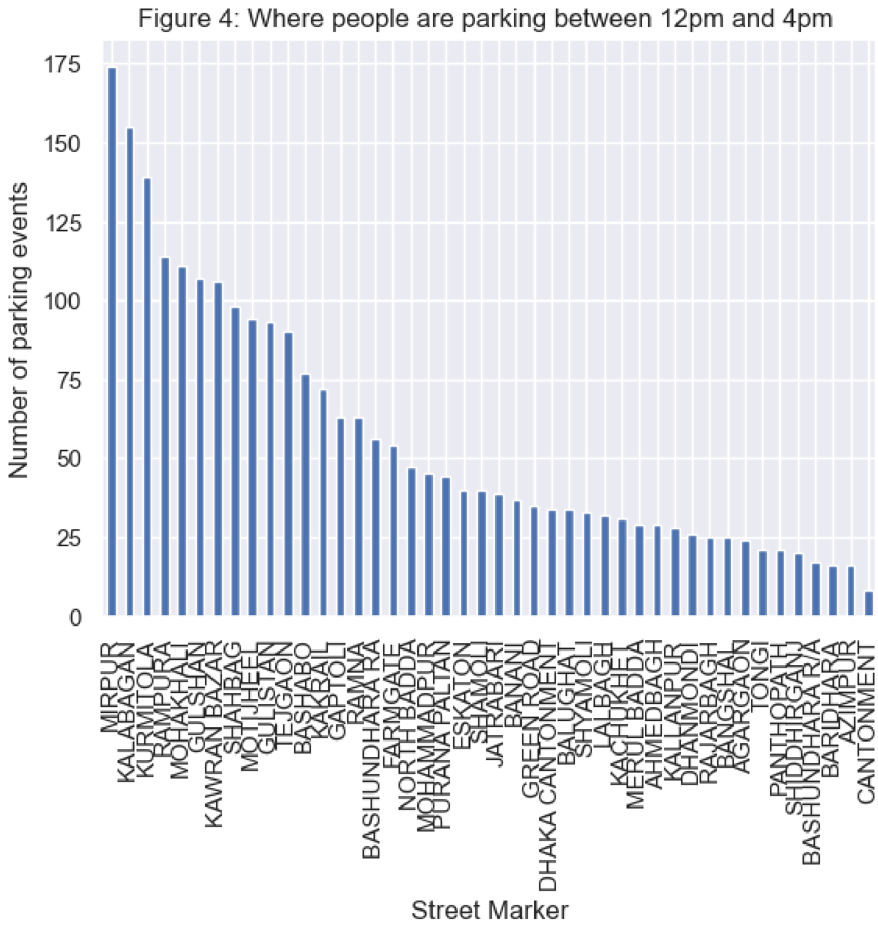


Figure 5.16: busiest hour for each area between 12pm and 4pm

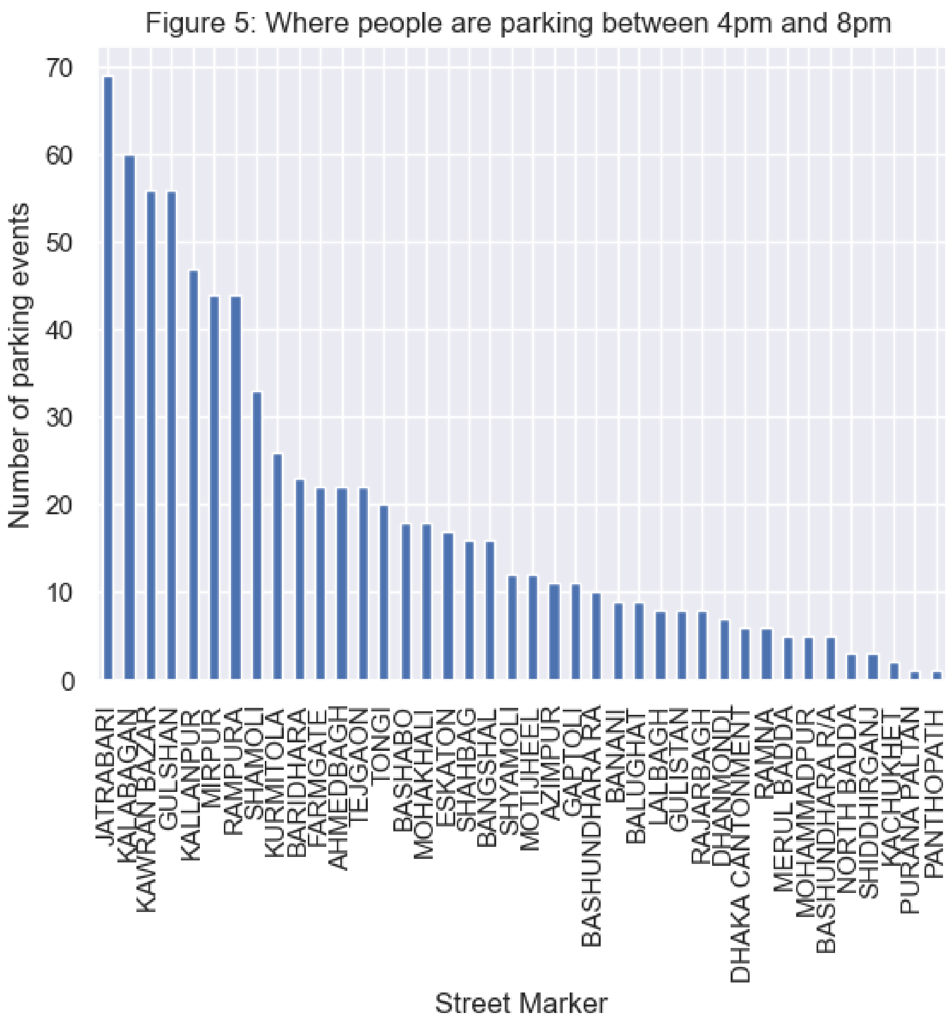


Figure 5.17: busiest hour for each area between 4pm and 8am

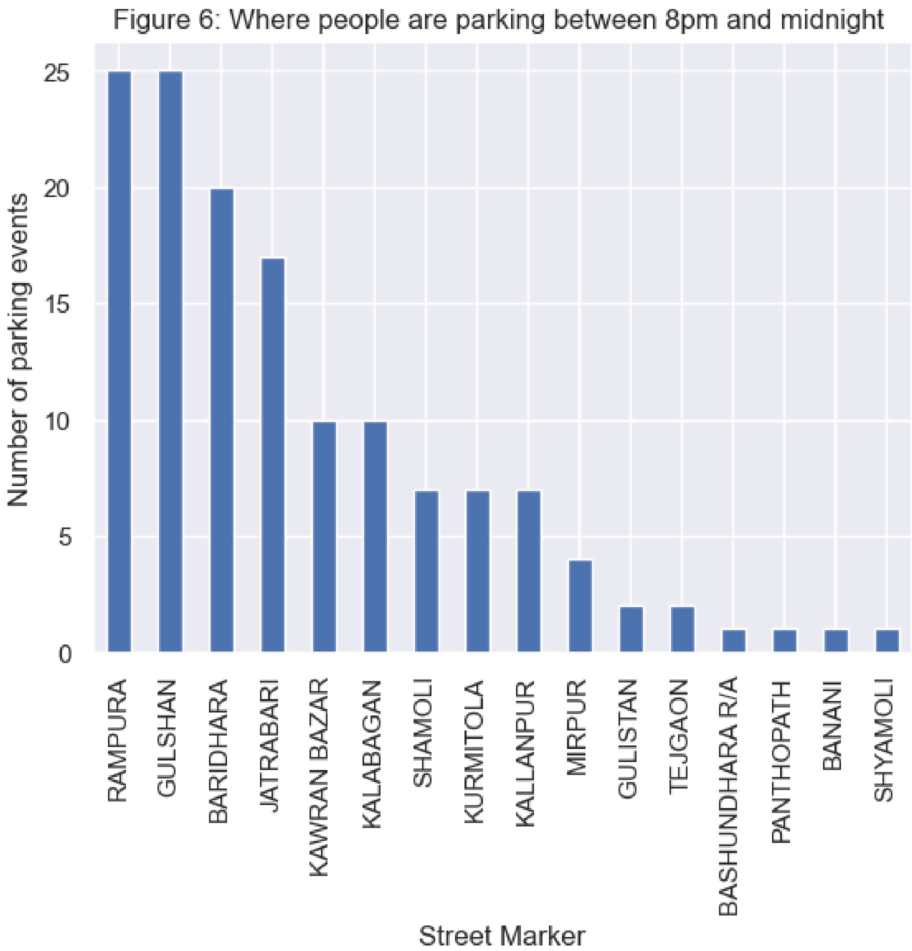


Figure 5.18: busiest hour for each area between 4pm and 8am

5.4 Parking location estimation using the K-Nearest Neighbor model

Figure 5.19: Q1 knn confusion matrix

```
Confusion Matrix
[[ 0  3  0 ...  0  0  0]
 [ 0 29  0 ...  0  0  0]
 [ 0  0  6 ...  0  0  0]
 ...
 [ 0  0  0 ...  2  0  0]
 [ 0  0  0 ...  0  4  0]
 [ 0  0  0 ...  0  0  2]]

[Train/test split] score: 0.94400
Classification Report
```

Table 5.1: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	94.4
Calculation Error	5.6
Precision (W avg)	93
Recall (W avg)	94
F1-Score (W avg)	94
K-Folds Score	98.4

5.5 Parking location estimation using the Decision Tree model

Figure 5.20: Q1 dt confusion matrix

```
[[ 25   0   0 ...   0   0   0]
 [  0 134   0 ...   0   0   0]
 [  0   0  17 ...   0   0   0]
 ...
 [  0   0   0 ...  29   0   0]
 [  0   0   0 ...   0  20   0]
 [  0   0   0 ...   0   0  34]]
Accuracy: 0.99901
```

Table 5.2: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	99.1
Calculation Error	.9
Precision (W avg)	100
Recall (W avg)	100
F1-Score (W avg)	100
K-Folds Score	99.998

5.6 Parking location estimation using the Support Vector Machine model

Figure 5.21: Q1 SVM confusion matrix

```
Confusion Matrix
[[ 60   0   0 ...   0   0   0]
 [  0 352   0 ...   0   0   0]
 [  0   1  42 ...   0   0   0]
 ...
 [  0   0   0 ...  86   0   0]
 [  0   0   0 ...   0  57   0]
 [  0   0   0 ...   0   0  96]]
```

Table 5.3: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	99.9
Calculation Error	.1
Precision (W avg)	100
Recall (W avg)	100
F1-Score (W avg)	100
K-Folds Score	99.9994

5.7 Parking location estimation using the Random Forest model

Figure 5.22: Q1 rf confusion matrix

```
[[ 60   0   0 ...   0   0   0]
 [  0 352   0 ...   0   0   0]
 [  0   0  43 ...   0   0   0]
 ...
 [  0   0   0 ...  86   0   0]
 [  0   0   0 ...   0  57   0]
 [  0   0   0 ...   0   0  96]]

 Accuracy score: 1.00000
```

Table 5.4: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	100
Calculation Error	0
Precision (W avg)	100
Recall (W avg)	100
F1-Score (W avg)	100
K-Folds Score	99.9997

5.8 Parking location estimation using the Naive bayes model

Figure 5.23: Q1 Nb confusion matrix

```
[[ 57   0   0 ...   0   0   0]
 [  0 123   0 ...   0   0   0]
 [  0   0  49 ...   0   0   0]
 ...
 [  0   0   0 ...  72   0   0]
 [  0   0   0 ...   0  49   0]
 [  0   0   0 ...   0   0  92]]
```

Table 5.5: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	93.73
Calculation Error	6.27
Precision (W avg)	95
Recall (W avg)	94
F1-Score	94

5.9 Arrival hour estimation using the K-Nearest Neighbor algorithm

Figure 5.24: Q2 knn confusion matrix plot

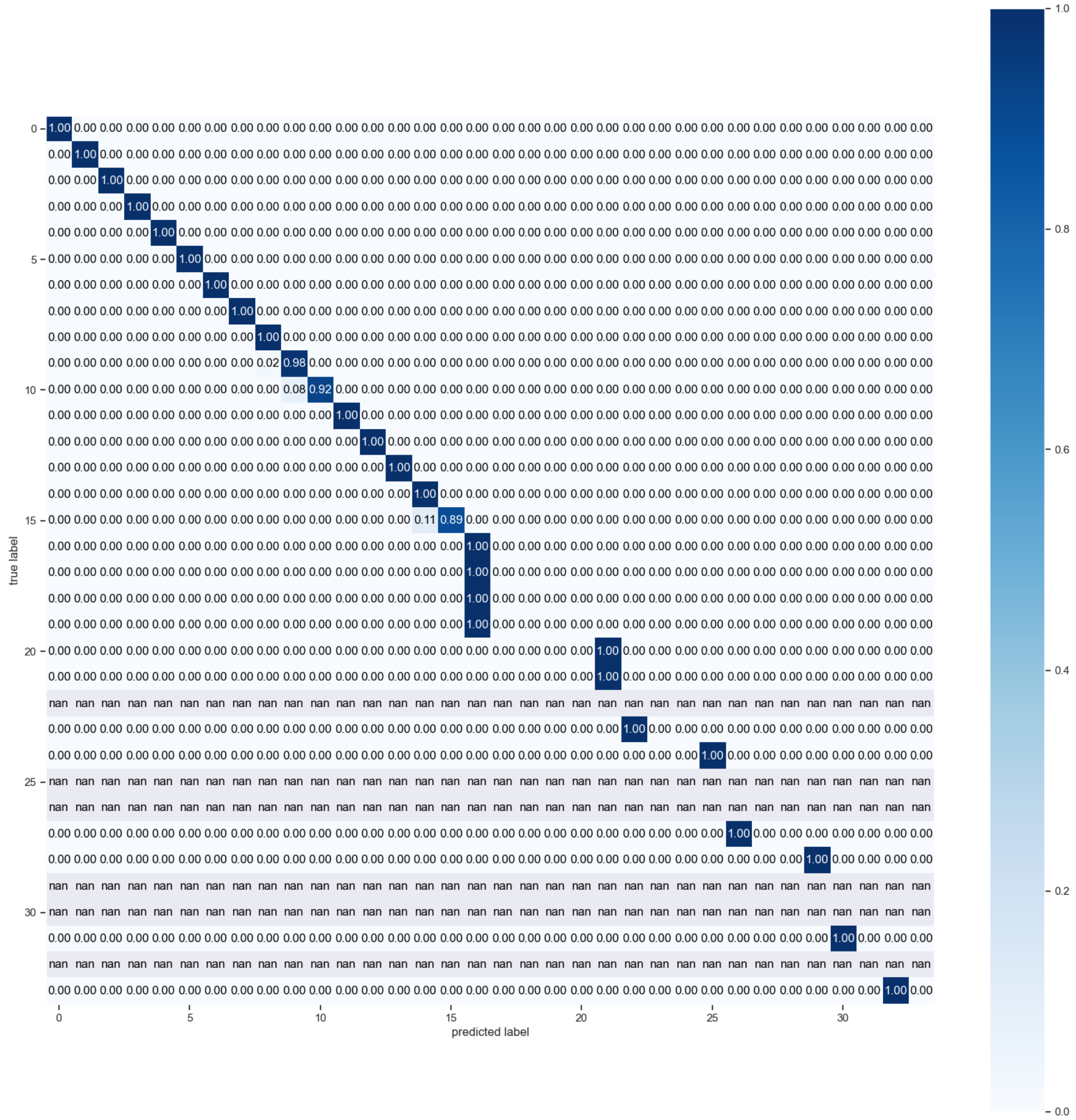


Table 5.6: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	99.1
Calculation Error	.9
Precision (W avg)	99
Recall (W avg)	99
F1-Score (W avg)	99
K-Folds Score	99.5

5.10 Arrival hour estimation using the Decision Tree algorithm

Figure 5.25: Q2 Dt confusion matrix plot

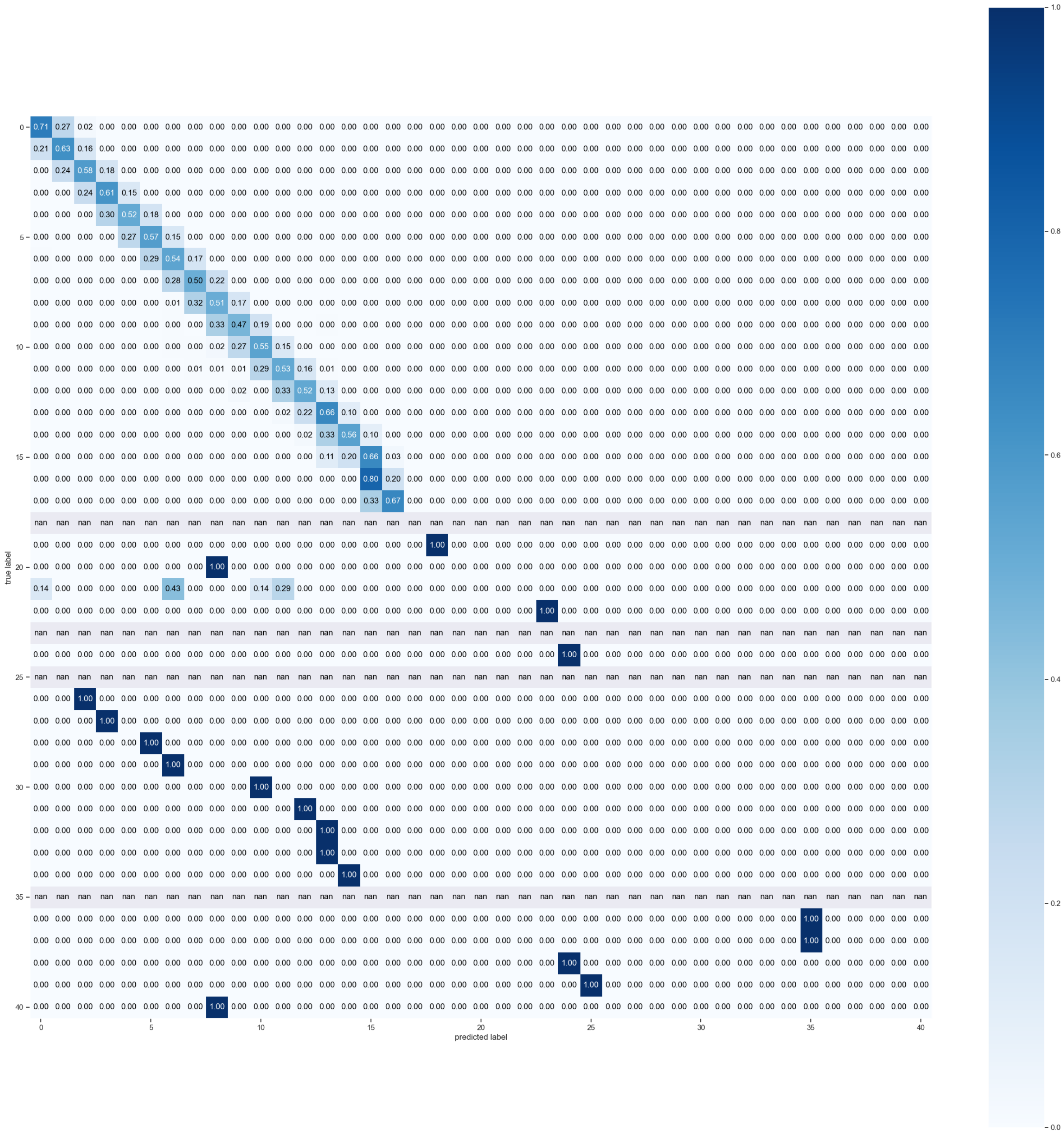


Table 5.7: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	56.6
Calculation Error	43.4
Precision (W avg)	56
Recall (W avg)	57
F1-Score (W avg)	56
K-Folds Score	56.6

5.11 Arrival hour estimation using the Random forest Tree algorithm

Figure 5.26: Q2 Rf confusion matrix plot

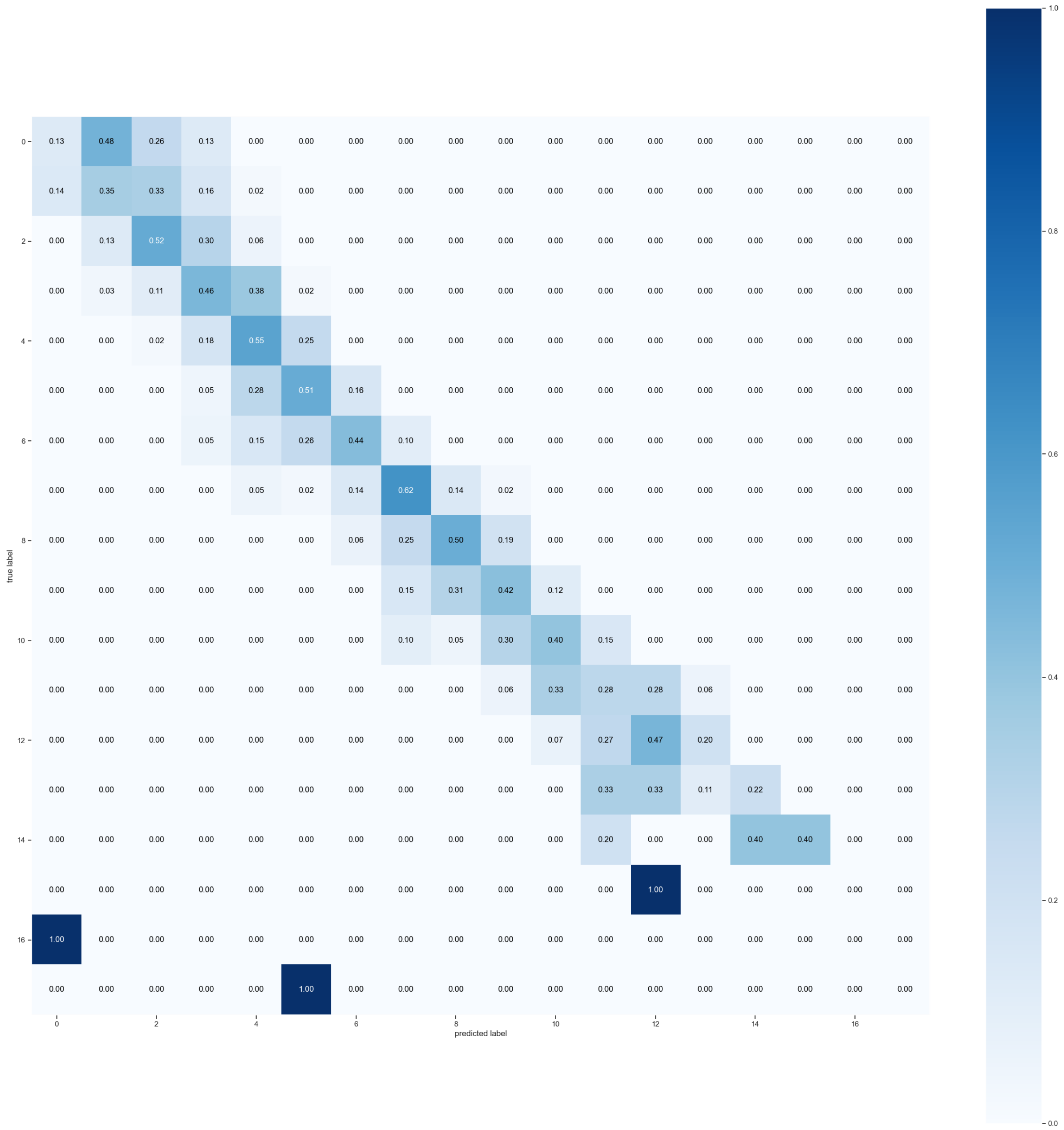


Table 5.8: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	56.4
Calculation Error	43.6
Precision (W avg)	57
Recall (W avg)	56
F1-Score (W avg)	56
K-Folds Score	56.8

5.12 Arrival hour estimation using the Support Vector Machine algorithm

Figure 5.27: Q2 svm confusion matrix plot

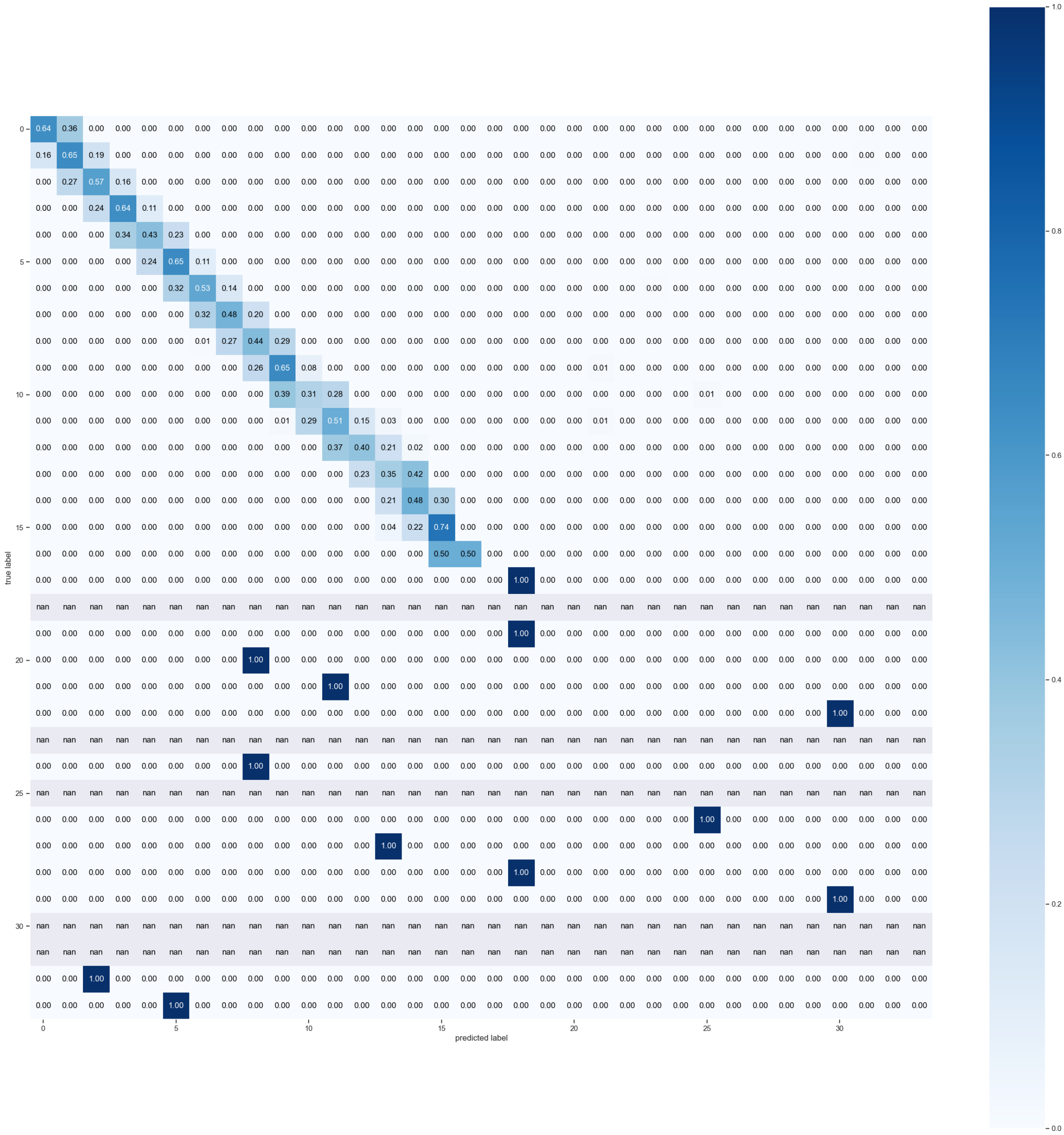


Table 5.9: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	55.53
Calculation Error	44.47
Precision (W avg)	56
Recall (W avg)	56
F1-Score (W avg)	55
K-Folds Score	57.46

5.13 Arrival hour estimation using the Naive Bayaes algorithm

Figure 5.28: Q2 Nb confusion matrix plot

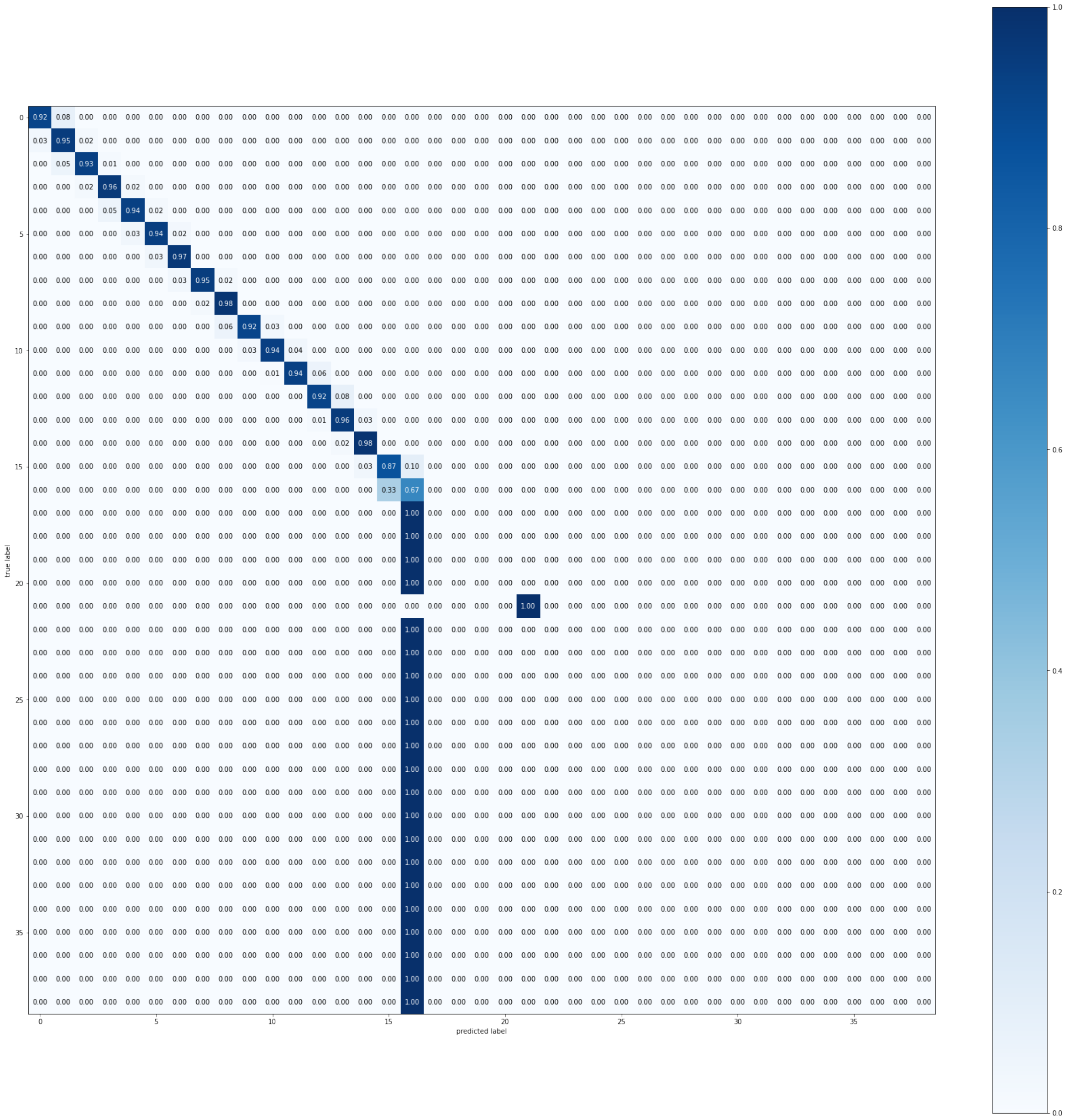


Table 5.10: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	94.06
Calculation Error	5.04
Precision (W avg)	94
Recall (W avg)	94
F1-Score	94

5.14 Available Space prediction using the Multi-layer perceptron

Figure 5.29: Q3 MLP confusion matrix plot

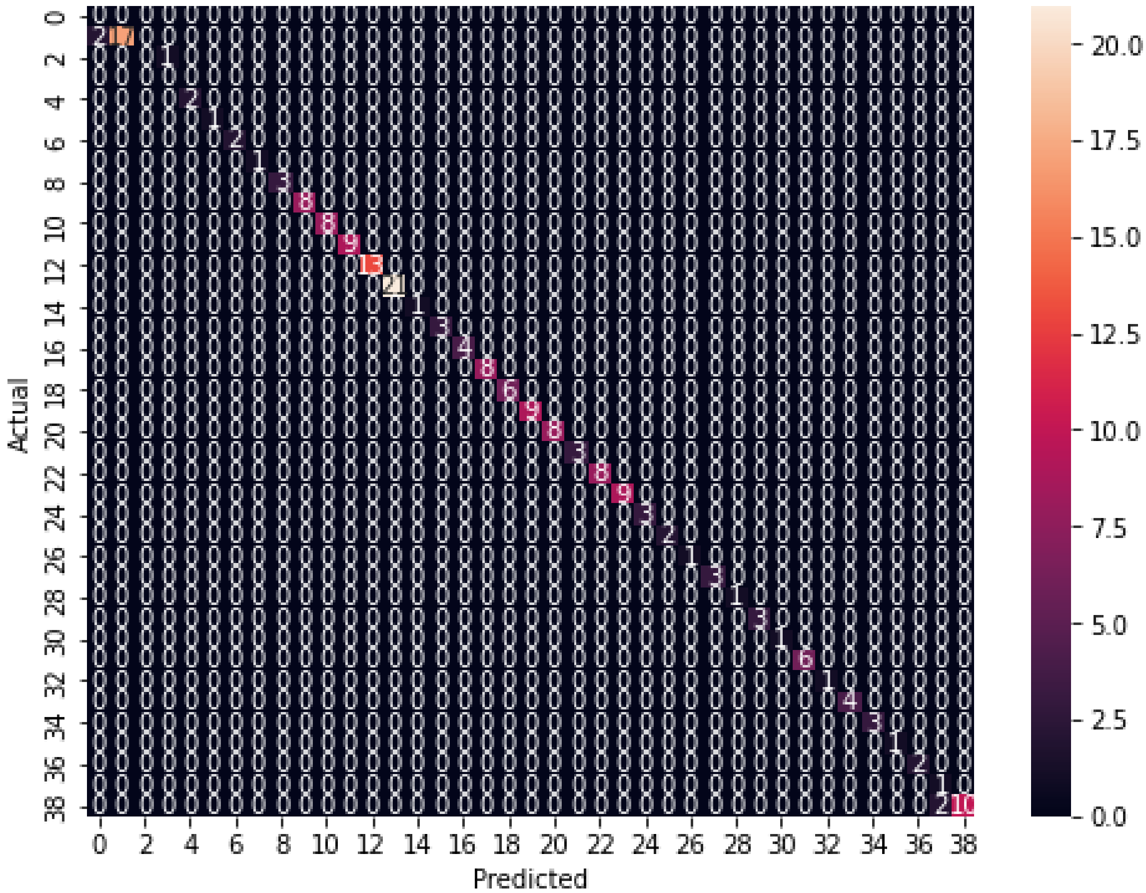


Table 5.11: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	99.60
Calculation Error	0.40
Precision (W avg)	100
Recall (W avg)	96
F1-Score	98

5.15 Available Space prediction using the RandomForest

Figure 5.30: Q3 RandomForest confusion matrix plot

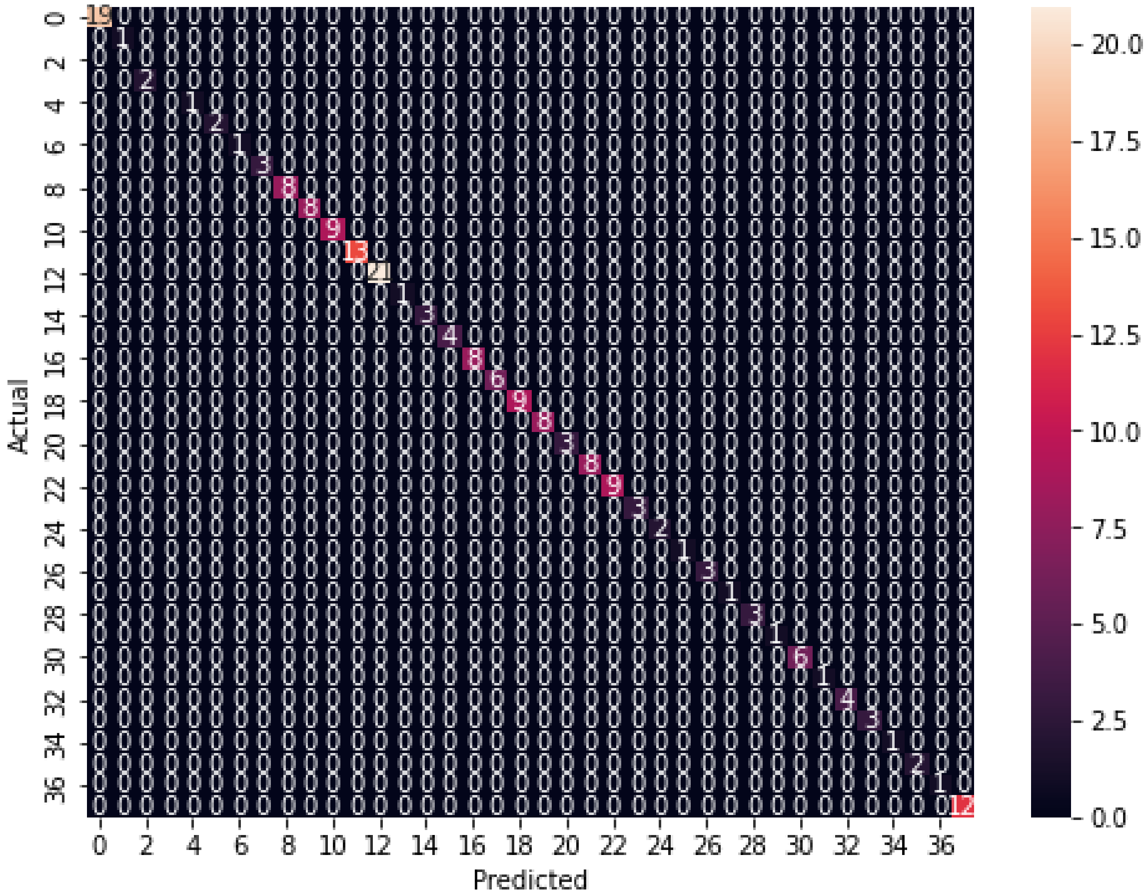


Table 5.12: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	99.32
Calculation Error	0.68
Precision (W avg)	99
Recall (W avg)	99
F1-Score	99

5.16 Available Space prediction using the Logistic Regression

Figure 5.31: Q3 LR confusion matrix plot

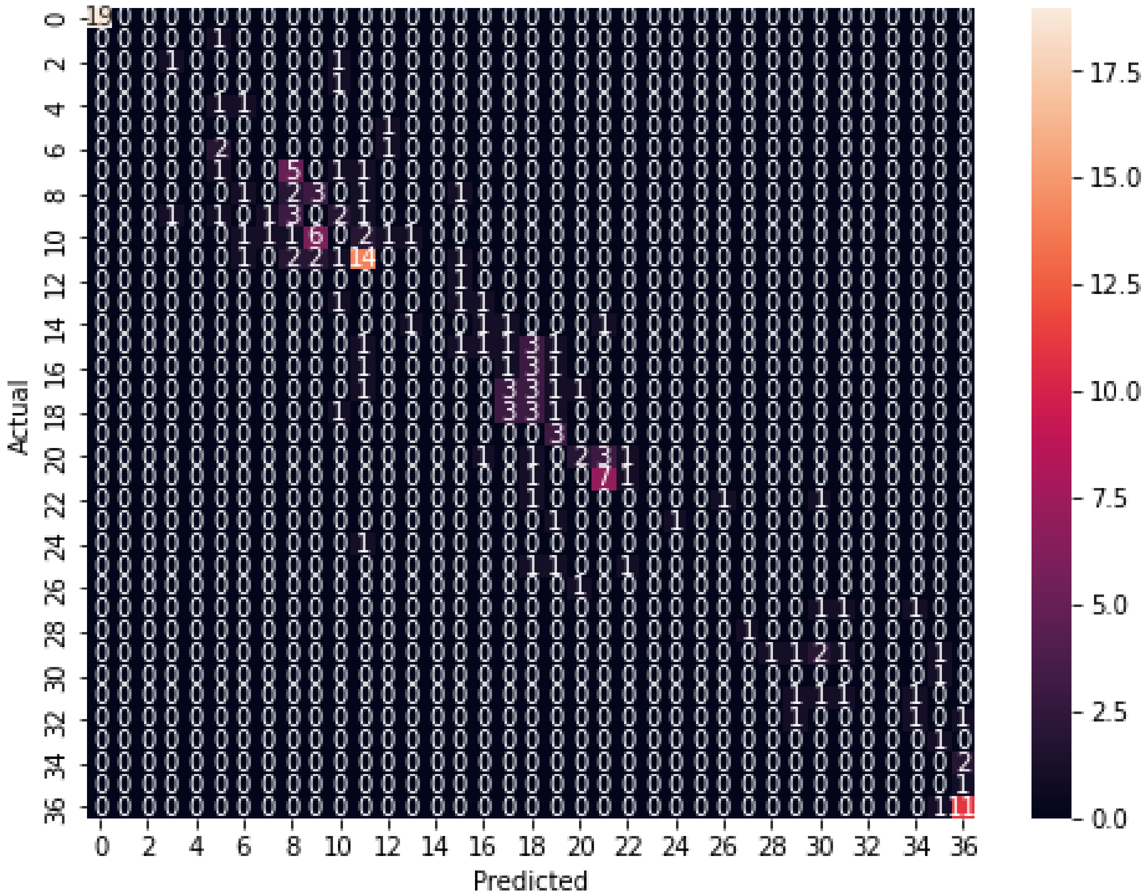


Table 5.13: Calculated output from Confusion Matrix

label	Accuracy
Accuracy	93.28
Calculation Error	6.72
Precision (W avg)	49
Recall (W avg)	53
F1-Score	50

Chapter 6

Discussions of Results

6.1 Machine Learning Algorithms Scores

We developed the comparison of our models below based on the findings and the debate, and we also developed additional prescriptive analyses. The following comparison chart is provided:

Table 6.1: Machine Learning Algorithms Scores

Question	Model	Accuracy Rate
Question 1	Random Forest	56.841
	Support Vector Machine	57.463
	K-Nearest Neighbors	99.52
	Decision Tree	56.663
	Naive Bayes	94.06
Question 2	Random Forest	99.97
	Support Vector Machine	99.901
	K-Nearest Neighbors	98.4
	Decision Tree	99.931
	Naive Bayes	93.73
Question 3	Multilayer perceptron	99.60
	Random Forest	99.32
	Logistic Regression	93.28

All the models did remarkably well in predicting the location of a parking occurrence. However, K-nearest neighbor stood out since it predicted the location with 99.52 percent accuracy and 98.4 percent on Question 2. But the accuracy of all the models was above 55 percent. All of the models achieved a very high score above 98 percent on the last test. Random forest Scored 56.841 percent on Question 2. support vector machine scored 57.463 percent. lastly, Decision Tree received the lowest score of 56.663 percent, while Random forest received the best score of 99.97 percent for the last question. where Support Vector Machine got 99.901 percent and decision tree got 99.931 percent. Therefore, generally, all of our models did quite well in relation to the several study objectives that we established at the beginning of the project, even if some models marginally outperformed others.

6.2 Visualizing Popular Parking Street

Finding which street to park during 12am to 4am which can be referred as the least busiest hour because people at that time reside at home that is why it is easier. From the given graph, we can visualize that most streets are least busy. The highest amount of car parking event is occurring at 8East Ulon Road Street. Other than that most of the streets have low activity where 87 Purana Paltan Road is the lowest. After that during 4am to 8am timeline, a lot of transports starts at that time as office hour of Dhaka city is around the corner. So we get to observe parking activities more frequently. If we observe the observe the graph from this timeline, Mirpur Road street parking systems seems more busier than other available parking streets. 104 Road at that time seems to have least amount of parking activities during that time. During the 8am to 12pm it is considered peak office hour. Not only the roads are busy with traffic the parking places in random streets face heavy activities. Almost every roads in Dhaka city face similar issue. Mirpur Road is considered the busiest street during this timeline whereas Zia Colony Road is considered the lowest among them but still containing activities. During the 12pm to 4pm timeline, most of the parking streets in Dhaka city is stacked with vehicles. There is subtle lack of parking space and people of Dhaka is no stranger to parking cars in street which results in more traffic jam. For heavy duties Mirpur Road is still considered the most crowded street having highest parking activities whereas in this timeline Jahirul Islam Avenue has the least amount of activity. After that, during 4pm to 8pm is the time for people return from office. So it is another time for traffic jam and increase in parking activities. Mirpur Road also remain the highest out of every other street in Dhaka whereas Noyapara road has the lowest. Finally, during 8pm to 12am, the shopping mall and food courts shuts down so most of the cars parked there start departing. From the graph we see that Baridhara Park street has highest number of parking events during this time and 104Road street has the lowest amount.

6.3 Visualizing Most Popular Parking Area

As for the most popular parking, during 12am to 4am timeline Rampura area is the most popular place for parking vehicles. During midnight, when there is not many vehicle running on the road. Purana Paltan is the least popular place among other places. As for the timeline 4am to 8am, it is the time of dawn and beginning of the day. As we can see from the graph Mirpur is the most popular place to park during this time of the day. Whereas Kalabagan seems to be the least popular area for parking. During office hour, in the timeline of 8am to 12pm, mirpur remains the most popular place for parking and purana paltan is the least popular place for parking during this time. At the timeline 12pm to 4pm when it is stacked with vehicles both in the parking places and the road sides, Mirpur still remains the most popular place for parking car. But even though there is too much traffic in Gulistan, it is not a suitable area for car parking which explains it being the least popular place for parking. During the hours from 4pm to 8pm when it is the time for people to take leave from the working place, Jatrabari is the most popular area for parking among the other areas. Here Baridhara is the least popular among other parking places during this time. When the shopping malls, food courts and other stores starts to shut down during 8pm to 12pm, Rampura is the most popular place for parking as we see from the graph and surprisingly Mirpur is the least popular area for parking during this hour.

6.4 Visualizing the busiest hour for each area

We investigated the correlation between the "Arrival time" and "Location name" columns to identify the busiest area during the specified time period. To identify parking occurrences that took place inside the specified window, we utilized the "datetime" function. After that, we plotted a bar graph using the data to determine the number of parking events that occurred in each region by using the "value count" function on the Area name column. 12:00 am to 4:00 am According to the graph, Rampura is the busiest places to park your car during this time period. Purana Paltan has the fewest cars parked there during this particular period. 4 am to 8 am From the graph, it is clear that Mirpur and Kurmitola are the busiest parking lots during this time period. Merul Badda, Azimpur, North Badda, Jatrabari, Ahmedbagh and Baridhara has the fewest cars parked there during this particular period. 8 am–12 pm According to the graph, Mirpur is the busiest parking lot during this time period, followed by Kurmitola and Gulistan. For this time period, the parking space in Jatrabari, North Badda, Bangshal, Mohammadpur and Shyamoli had the fewest occupants. 12 to 4 p.m. According to the graph, Mirpur, Kalabagan and Kurmitola are the busiest places to park your car during this time period. For this time period, the parking space in Cantonment had the fewest occupants. 4 to 8 p.m. From the graph, it is clear that Jatrabari and Kalabagan are the busiest parking lots at this time period. For this time period, the parking space in Purana Paltan and Panthopath had the fewest occupants. 8 p.m. to 0 a.m. According to the data, Rampura and Gulistan is the busiest parking lot during this time period, followed by Baridhara and Jatrabari. For this time period, the Bashundhara r/a, Panthopath, Banani and Shyamoli parking space has the fewest vehicles parked there. popular location (any given time) According to the graph, Mirpur is by far the most popular parking location, making it exceedingly challenging to get a space there.

6.5 Data Modelling of a Prediction of a parking location using K-Nearest Neighbour classification model

The K-Nearest Neighbour (KNN) classification algorithm has a 98.4 accuracy rate when used to determine which street the parking record was on. Based on its other attributes, the algorithm was able to accurately estimate the location (street) of a parking record almost 10 times out of 10. Visualization of the Confusion Matrix and Classification Report There is no heatmap visualization for the supplied confusion matrix in this business inquiry. This is because there are so many classes that the visualization is unreadable. This does not harm the study because the accuracy score and classification report that are derived from the confusion matrix give sufficient information into the confusion matrix's behavior. (The original matrix is shown in

Figure 7.18)
Report on Classification: F1 Score, Precision, and Recall In terms of positive observations, precision is the proportion of accurately anticipated observations to all expected positive observations. Recall is the portion of the class's observations that were properly forecasted as positive to the entire class's observations. Both of which are 94 percent for KNN with this business query (Figure 7.18). This indicates that the model was able to be trained sufficiently to make accurate predictions almost 94 percent of the time, regardless of whether you focus on the range of right predictions in positive observations or all observations. The weighted average of the two metrics, the F1-Score (Figure 7.18), may be a more helpful indicator for data that is uneven. Table 7.1 shows that the first few classes in this model are clearly given more weight than the final few. Increased K-Folds Score These findings, which have so far been examined, came from a strict training regimen of ALL TRAINING ALL TESTING. K-Folds cross validation was used to increase the KNN model's potential accuracy score even further. With the testing segment occurring at various moments throughout the training data, this repeatedly executes the training-testing method. The testing data is divided into several "folds," each of which represents a unique environment condition that the model may experience and learn from. The accuracy score was increased by 4 percent (98.4 percent - Table 7.1) thanks to the K-Folds approach, showing that this was only moderately successful. This is a notable improvement in the context of machine learning techniques given that just 5 folds were Consequently, just 5 different testing environments were employed. The accuracy of KNN on this business question can be increased with future research into new folds and repetition type testing.

6.6 Data Modelling of a Prediction of a parking location using Decision Tree classification model

The decision tree classifier has a 99.931 percent accuracy rate in guessing the street name of a parking incident. The model can predict the position with a high degree of precision, as evidenced by its 100 accuracy, recall, and f1-score. Fivefold cross validation was used to train and test the data, and the result was 99.931. The objective is to learn straightforward decision rules derived from the data characteristics in order to build a model that predicts the value of a target variable. From figure 7.3 we get to see the visual representation of parking occupancy rate. During this test K-Folds Accuracy was ran 5 folds and it scored 99.998. Our overall score was very close to getting 100 which can verify that it can give the best result.

6.7 Data Modelling of a Prediction of a parking location using Random Forrest

Using Random Forest, we also attempted to forecast where a specific parking incident will occur. In this situation, random forest has a 100 percent accuracy rate. However, the accuracy did somewhat decrease during the k-folds cross validation, falling to 99.9997 percent, which is still quite accurate for answering this question.

The accuracy, recall, and F1-Score weighted average scores were all 100 points when we again chose this option. Once more, the classes were unbalanced, yet the random forest was still able to accurately forecast the location.

6.8 Data Modelling of a Prediction of a parking location using Support Vector Model

Using SVM, we attempted to predict the location of a certain parking occurrence in this query. SVM excelled in answering this query and received a almost score of 99.9 percent. Unfortunately, the accuracy score of the model decreased significantly after we performed k folds, giving a score of 99.9994. We can also observe from the classification report that the model gave us fantastic scores for recall, F1 score, and accuracy.

6.9 Data Modelling of a Prediction of a parking location using Naive Bayes Model

Accuracy Score for Naive bayes is 93.73 percent and miscalculation rate was 6.27 percent. precision is 95 percent both Recall and F1- Score is 94 which are a great Accuracy.

6.10 Data Modelling of a Prediction of parking time using K-Nearest Neighbour classification model

The K-Nearest Neighbour (KNN) classification model has an accuracy rating of 99.1 percent when used to determine which street the parking record was on. In other words, based on its other properties, Nearly 10 out of 10 occasions, the model was successful in accurately predicting the time (arrival hour) of a parking record. The dataset slice utilized in this example is imbalanced. Model: KNN. The confusion matrix shows this (figure [26]) The prior courses' True Positive Scores and variety of False Positive Scores reflect actual outcomes. There are no True Positive Scores from class 4 on up to class 14, hence this is true. This isn't, however, because the model can't categorize such results. This is because the dataset slice used for model testing did not contain data from those tail end classes. Due to this imbalance, the weighted average rather than the macro average was utilized to derive Classification Report (Table 7.6) metrics like Precision, Recall, and F1-Score. This is so that the 0s in the matrix are recognized as non-entries rather than failures by the weighted average. Once we had those weighted averages, the True Positives of the KNN Model still yielded rather high results. Precision = 99, Recall = 99(Table 7.6). We may infer from these metrics that the model was able to retain above average accuracy despite not having been thoroughly tested-trained on a significant sample of the target's classes. Increased K-Folds Accuracy These findings, which have so far been examined, came from a strict training regimen of ALL TRAINING

ALL TESTING. K-Folds cross validation was used to increase the KNN model's potential accuracy score even further. With the testing segment occurring at various moments throughout the training data, this repeatedly executes the training-testing method. The testing data is divided into several "folds," each of which represents a unique environment condition that the model may experience and learn from. The accuracy score was increased by 0.4 percent (99.5 - (Table 7.6)) thanks to the K-Folds approach, showing that this was only moderately successful. Given that just 5 folds were implemented, which means only 5 separate testing settings were utilized, this is a substantial improvement in the context of machine learning algorithms.The accuracy of KNN on this business question can be increased with future research into new folds and repetition type testing.

6.11 Data Modelling of a Prediction of parking time using Decision Tree classification model

56.6 of the time, a decision tree classifier can predict with accuracy how long a parking event will last. The classification report generated by Sklearn served as the basis for calculating precision, recall, and F1-score. Recall is 57, accuracy is 56.6, and the F1 score is 56. These results are really bad because they are all below 90. The K-folds cross validation average score is roughly 56.6 with five folds, which is sufficient. However, the model's other metrics imply that it is insufficient to reliably predict how long a parking issue will last.

6.12 Data Modelling of a Prediction of parking time using Random Forest classification model

Random Forest performed fair in estimating the length of time a car will be parked. Its accuracy rating is 56.4 percent. And after applying k-folds validation it slightly enhanced it to 56.8 percent. According to the classification report, the accuracy, recall, and F1-score are all fair for this model at 57, 56, and 56 percent respectively.

6.13 Data Modelling of a Prediction of parking time using Support Vector Model classification model

Random Forest performed well in estimating the length of time a car will be parked. It does have a fair accuracy rating of 55.53 percent. And after applying k-folds cross validation to it, we slightly enhanced it to 57.46 percent. the categorization report that Sklearn produced. To determine the weighted average score for accuracy, recall, and F1-Score, classification report function was employed. A weighted average score was used. But our statistics are not accurately described in that way. The weighted average score also calculates a score based on the null values that the classes provide.

6.14 Data Modelling of a Prediction of a parking location using Naive Bayes Model

Accuracy score of 94.06 Naive Bayes Model which was almost picked up the correct prediction. 94 for both precision and recall (Table 7.6). These results indicate that the model was able to retain above average accuracy despite not having been thoroughly tested-trained on a sizable sample of the target's classes.

6.15 Data Modelling of a Prediction of a parking Available Space using Multilayer perceptron Model

When using the multilayer perceptron model for our question 3 which is to show the available parking space at a particular time of the day we used this model as it is best for searching. Our dataset scored 99.60 in this model.

6.16 Data Modelling of a Prediction of a parking Available Space using Random Forest Model

We once again used Random Forest model to answer question 3. As it is great for prediction and analyse behavior of a dataset. It gave us 99.32 accuracy score in terms of finding out available space in a particular parking space.

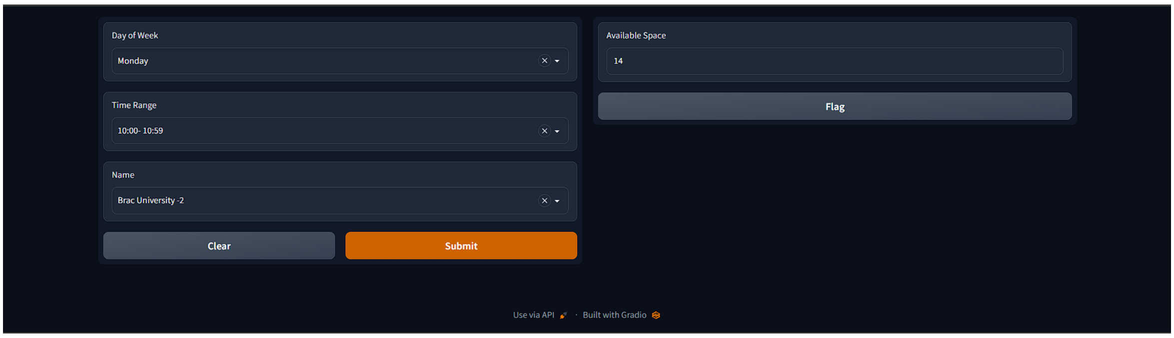
6.17 Data Modelling of a Prediction of a parking Available Space using Logistic Regression Model

Lastly we used logistic regression model for question 3. It is mainly used for prediction and classification. It is based on independent variable of dataset and it estimates an event occurrence. Using our dataset, logistic regression model has scored 93.28 for our dataset.

6.18 Providing parking advice based on the available time frame

After the analysis of all the parking locations each area over time in order to propose a parking location for a specific time of the day. We divided the times into blocks of four hours. The suggestions are Midnight 12 to 4 am in the morning: Based on an analysis of Figure 7.13, we advise parking at the Purana paltan because there are much less people there than at the other parking locations during this period. 4am-8pm: We advise parking in the Baridhara , Jatrabari or Cantonment parking place for this duration after analyzing figure 7.14.8pm to For this time, Shymoly has a very small number of parking events. 8 p.m. to 12 a.m.: Based on our analysis of Figure 7.18 , we suggest parking at Parking Space because it has the least We presumed that the parking space was blocked for the time when the parking events did not appear for that time period. Given that Jatrabari had the least amount of parking requests overall, it was the most often suggested parking location. Also, a user can see available space in any parking garage in a specific time range like figure 6.1.

Figure 6.1: Available Space Prediction In particular time frame Interface API



Chapter 7

Conclusion

In today's digital era, the pursuit of global planning of economic organization in a world defined by environmental discussions, economic association, and agreements on global trade is the goal. This era has given us solutions to almost every type of daily problems we are facing. In a city like Dhaka where traffic and parking place is a crucial topic to discuss it is high time that an initiative is taken to lower the problem that people are facing in their day to day work life[10].
The automatic recognition of cars entering or exiting a parking space is a crucial step toward a smart parking system. It is feasible to estimate how many parking spaces are available in a parking zone by detecting a parking or departing event. The increasing amount of the area occupied by parked automobiles, which has a significant impact on traffic, is one of the major challenges of urban traffic. The advancement of industrial automation has already reached the point where smart parking designers may be offered trustworthy and effective solutions. Only an innovative, cutting-edge control system will be able to meet the growing demands of clients. Globally developing motorizing as well as urbanizing situations that is creating new challenges for the city building planners. Throughout our research we aimed for finding out efficient parking system by researching and running tests the existing parking systems. The existing system shows that some of the places have too much parking activities where some parking places are the exact opposite. Our goal was to make efficient use of parking spaces and minimize the crowd in the overly crowded places. If it is implemented then common people will have less hassle for parking.[5].
Because the industry is always evolving and new approaches are being developed, software solutions adapted to type designs should be expected in the future. This necessitates the creation and standardization of software components on an ongoing basis.

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